CLIMATE CHANGE ADAPTATION

Second Round

30 May 2015

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Board Assurance

The Board of Portsmouth Water is responsible for the strategic development of the Appointed Business and takes this issue seriously at all times.

Portsmouth Water recognises that understanding future challenges such as Climate Change forms an increasingly important part of the Company's long term approach to planning in order to maintain the current high levels of service.

Notably climate change is likely to have varying effects throughout the business including the sufficiency of water available for supply, changing levels of demand, the quality of water we abstract and the resilience of our assets. The risks identified in our first round Climate Adaptation report published in 2011 are not new to the Company, many are controlled through business-as-usual activities whilst the current company risk mechanisms and regulatory framework ensure a forward looking approach to managing increasing levels of climate risk. As such, the approach taken in our 2011 plan was to build further adaptive capacity.

Four years on since the first round adaptation plan was published, in this report we have reviewed our actions and how climate risks have been incorporated into investment decisions and demonstrated positive progress towards increasing our resilience to climate factors as a Company, recognising that the plan is an ongoing process. We will endeavour to further integrate climate change into our decision making processes. In the second round report we also undertaken a re-evaluation of our priority risks identified from our 2011 report, whilst some risks have been reduced as a result of our investment, given the long term nature and uncertainty of climate change few risks have significantly changed since 2011. None the less, the process of re-evaluating climate risk and our adaptation plan has served as an important reminder throughout the Company of potential future risks that climate change presents.

Neville Smith

Managing Director

Portsmouth Water & Adaptation Reporting

The Company

Portsmouth Water has been supplying water to the city of Portsmouth and the surrounding area since 1857. It supplies an average of 170 million litres of water every day to a population of 700,000, together with over 18,000 businesses, in an area of 868 square kilometres that straddles the border between Hampshire and West Sussex. The area of supply ranges from Fareham and Bishop's Waltham in the west to Ford and Middleton-on-Sea in the east, and inland as far as the highest points of the South Downs. The majority of the population lives on the coastal plain in the urban areas of Fareham, Gosport, Havant, Waterlooville, Portsmouth, Chichester and Bognor Regis.

Portsmouth Water's mission statement is:

> *"We aim to supply drinking water of the highest quality providing high levels of customer service and excellent value for money"*

Portsmouth Water Activities:

- Water Abstraction
- Raw Water Transportation
- Raw Water Storage
- Water Treatment
- Potable Water Storage
- Potable Water Transportation
- Customer Billing/Retail

Background to the report

The Climate Change Act (2008) provided the Secretary of State the power to direct reporting authorities to provide information detailing the following:

- The current and future predicted impacts of climate change on their organisation
- Proposals for adapting to the impacts of climate change
- An assessment of progress towards implementing the policies and proposals set out in the previous round reports.

The first round of reporting in 2011 focused upon major public infrastructure providers from the energy, transport and water sectors.

The aims of the Portsmouth Water Round 1 report were as follows:

- Identify the impacts of a changing climate on Portsmouth Water's ability to carry out its functions and continue to deliver secure, wholesome water supplies
- Assess and prioritise climate risks
- Identify adaptation options
- Identify knowledge gaps and barriers to action
- Develop a robust, evidenced adaptation plan
- Outline adaptation measures being taken

In this current second round of reporting, Defra has adopted a voluntary approach in order to provide companies with the flexibility to identify their own adaptation plans and to avoid any unnecessary duplication with existing regulation. In addition to inviting organisations from new industries to report for the first time, companies that took part in round 1 of the report, such as Portsmouth Water, has been invited to provide updates on the progress of their adaptation plans submitted in 2011.

The first round report demonstrated that Portsmouth Water through the existing regulatory, legislative and company drivers has capacity to adapt to risk and uncertainty. Accordingly, the 2011 climate change action plan focused upon explicitly identifying climate change factors and integrating them within the Company's existing risk mechanisms.

The company uses both a bottom-up and top-down approach to managing risk. From a top-down perspective the company has a risk register which contains climate change factors where appropriate. Items on the risk register which require some form of action are also reviewed by the board quarterly and the risk register is reviewed in full on an annual bases. The 2011 climate change action plan resulting from the Round 1 report however was concerned with building capacity within the risk four mechanisms that form the Company's bottom-up approach to managing risk:

1. Capital Planning
2. Drinking Water Safety Plan
3. Water Resources Management Planning and Drought Planning
4. Resilience and Emergency Planning

In alignment with Defra's guidance, the Portsmouth Water second round report will not be a complete adaptation reporting process, rather an update to the first round report.

Aims of this report:

- Re-cap outcomes of the first round
- Provide an update on the progress of the 2011 action plan
- Update the 2011 actions where appropriate
- Demonstrate resilience through capital planning
- Review the barriers to change, opportunities and interdependencies
- Re-evaluate priority risks 4 years on

The First Round: Outcomes

This section summaries the outcomes in terms of identifying and prioritising risk which feeds into the corresponding action plan to enable the company to build further capacity for climate adaptation into the existing risk mechanisms. The approach taken to assessing risk was a top level quantification of climate risk using UKCP09 data in conjunction with internal data, experience and expertise to consider the Company's vulnerability to climate change. For a full breakdown of the methodology, risk quantification and climate factors please see the Round 1 of the report.

A Summary of Climate Change Risks

Strategic Level

Sufficiency of Water Available in Existing Sources - Climate change may lead to differing rainfall in the future years in quantity and frequency. Consequently there is a risk that in the future there will not be sufficient water available in existing sources to meet projected demand.

Increasing and Changing Demand Patterns for Water - The changing climate is likely to result in changes to the amount of water people wish to use and the times of the year they wish to use it. This may result in potential shortages of water which could be exacerbated by changes to the availability of water in the environment.

Quality of Water Available for Abstraction - Climate change has the potential to cause a deterioration in the quality of the raw water abstracted at some sources. This has the potential to trigger major investment requirements to provide suitable treatment or abandonment of the source.

Performance of Assets - Climate change may impact the deterioration rate, failure modes and operating efficiency of the Company's assets associated with abstracting, treating and distributing water.

Resilience of Assets - The Company's assets will be exposed to more extreme weather events in the future. Increased risk of flooding from intense rainfall events has the potential to impact the reliability of the water supply.

Sea Level Rise - Portsmouth Water's area of supply includes a significant proportion of coast line. The projected sea level rise presents a risk to some of Portsmouth Water's assets that are sited along the coast.

By Function

The breakdown below identifies the climate change inputs that were applied to the Portsmouth Water risk assessment of Climate Change using UKCP09 data. From the climate change risk assessment many of the items were considered to be of low risk in the short, medium or long term. For example although saline intrusion is recognised as a risk, the majority of Portsmouth Waters assets are located on high ground e.g. South Downs whilst below ground assets such as water mains are under pressure and so the risk is low. Please refer to section 7 of the Round 1 Report for the detailed discussion on climate change factors by function.

Water Resources

The process of strategically managing the supply/demand balance and preparing the statutory 25 year Water Resources Management Plan.

Sea Level Rise

- Saline intrusion; borehole sources no longer viable due to rising salinity.
- Saline intrusion; springs source no longer viable due to rising salinity
- Estuarine reaches move upstream resulting in rising salinity at the River Itchen Source
- Asset loss due to coastal change
- Population migration away from areas at risk of coastal change

Reduced Summer Rainfall

- Reduced aquifer recharge during summer months leading to lower groundwater levels and reduced source yield
- Reduced groundwater levels leading to saline intrusion
- Increased abstraction by other (existing) catchment users
- Increased risk of breach of environmental flow requirements in water courses, reducing reliability of sources
- Increased peak demand for water from permanent population
- Increased occurrence of drought

Increased Winter Rainfall

- Population migration out of floodplain impacting on the supply/demand balance
- Increased aquifer recharge during winter (climate change opportunity)

More intense winter rainfall

- Increased compaction of soil surface leading to greater run-off and reduced aquifer recharge
- Population migration away from areas at risk of surface water flooding

Reduced cloud cover

- Increase in agriculture and horticulture leading to increased abstraction by other catchment users

Increased summer temperatures

- Increased evapotranspiration
- Increased peak demand for water from permanent population
- Increased demand for water from seasonal (tourist) population
- Increased demand from net inward migration of retirement population
- Increased soil fracturing in summer leads to accelerated aquifer recharge when rains begin (climate change opportunity).

Abstraction

The operational activity of sourcing water of sufficient quality and in sufficient quantity, and has a number of assets associated.

Sea Level Rise

- Asset loss or outage from coastal change

Reduced Summer Rainfall

- River intake too high due to reduced river flows

Increased Winter Rainfall

- Increased flood risk from groundwater and rivers

More intense winter rainfall

- Increased risk from pluvial flooding
- Increased interruptions to electricity supply

Increased Storminess

- Increased interruptions to electricity supply
- Increased interruptions to telecommunications and telemetry

Increased summer temperatures

- Reduced operating efficiency of pumps
- More extreme wetting and drying cycles leading to accelerated asset deterioration
- Increased occurrence of heat wave events

Raw Water Quality

The process of managing water quality risks in our raw supplies which arise due to other catchment operators and hydrogeological properties of the region

Reduced Summer Rainfall

- Lower river flows in the River Itchen cause pollutants to become more concentrated
- Lower river flows in the River Itchen cause water temperatures in the water to rise

More intense winter rainfall

- Increased surface runoff leading to increased water quality events

Reduced Cloud Cover

- Increased biological growth in the water

Increased summer temperatures

- Higher water temperatures (river source)

Raw Water Transportation

Sea Level Rise

- Asset loss or outage from coastal change
- Saline intrusion of raw water mains causing increased water quality risk

Raw transportation is the function of transporting raw (untreated) water, either for nitrate blending purposes or to a treatment works.

The function has a number of assets associated such as pumps and mains.

Increased summer temperatures

- Reduced operating efficiency of pumps
- More extreme wetting and drying cycles leading to accelerated asset deterioration (above ground assets)
- More extreme wetting and drying cycles leading to accelerated asset deterioration (below ground assets)
- Increased occurrence of heatwave events

Increased Winter Rainfall

- Increased flood risk from groundwater and rivers

More intense winter rainfall

- Increased risk from pluvial flooding

Increased Storminess

- Increased interruptions to electricity supply
- Increased interruptions to telecommunications and telemetry
- Storm damage to buildings and overhead cabling

Raw Water Storage

The Company has very limited raw water storage facilities. This function is limited to a single concrete structure located on site at one treatment

Sea Level Rise

- Asset loss or outage from coastal change

Increased summer temperatures

- More extreme wetting and drying cycles leading to accelerated asset deterioration

Increased Winter Rainfall

- Increased flood risk from groundwater and rivers

More Intense Winter Rainfall

- Increased risk from pluvial flooding

Treatment

Sea Level Rise

- Asset loss or outage from coastal change

Increased summer temperatures

- Reduced operating efficiency of pumps (M&E)
- Bacterial growth in rapid gravity filters
- More extreme wetting and drying cycles leading to accelerated asset deterioration

The process of treating water to potable standards through mechanical and chemical means, and has a number of assets associated.

- Increased occurrence of heat wave events impeding works access
- Increased occurrence of heat wave events disruption chemicals supply chains

Increased Winter Rainfall

- Increased flood risk from groundwater and rivers
- Supply chain disruption from regional flooding preventing access to works

More Intense Winter Rainfall

- Increased risk from pluvial flooding

Increased Storminess

- Increased interruptions to electricity supply
- Increased interruptions to telecommunications and telemetry
- Disturbance of flocculant blanket in clarification process
- Storm damage to buildings and overhead cabling

Reduced Cloud Cover

- Algal growth in rapid gravity filters (River Itchen works)
- Algal growth in clarifiers

Potable Storage

The process of storing water in service reservoirs from which water feeds to the customers' tap.

Sea Level Rise

- Saline intrusion from sea level rise
- Asset loss or outage from coastal change

Increased summer temperatures

- Reduced operating efficiency of mechanical and electrical equipment
- More extreme wetting and drying cycles leading to accelerated asset deterioration
- Accelerated chlorine depletion due to increased bacterial growth

Increased Winter Rainfall

- Increased flood risk from groundwater and rivers
- Asset damage from flooding
- Monitoring equipment failure due to flooding

More Intense Winter Rainfall

- Increased risk from pluvial flooding
- Asset damage from flooding
- Monitoring equipment failure due to flooding

Potable Transport

The process of transporting water from a treatment works to a service reservoir, and from the service reservoir to the customers' tap.

Sea Level Rise

- Saline intrusion of water mains from sea level rise leading to water quality risk
- Population migration away from areas at risk of coastal change; network sizing inappropriate
- Asset loss (water mains) due to coastal change

Increased summer temperatures

- Reduced operating efficiency of mechanical and electrical equipment
- More extreme wetting and drying cycles leading to accelerated asset deterioration
- Accelerated chlorine depletion
- Increased seasonal (tourist) population; network sizing is insufficient

Increased Winter Temperatures

- Reduction in mains bursts associated with frozen earth (climate change opportunity)

Increased Winter Rainfall

- Increased regional flooding; infiltration of below ground assets
- Increased flood risk to pumps, valves etc. (above ground assets)
- Population migration away from areas at risk; network sizing inappropriate
- Regional flooding impeding routine mains repair

More Intense Winter Rainfall

- Increased regional flooding; infiltration of below ground assets
- Increased flood risk to pumps, valves etc. (above ground assets)
- Population migration away from areas at risk; network sizing inappropriate
- Regional flooding impeding routine mains repair

Increased Storminess

- Increased interruptions to electricity supply
- Increased interruptions to telecommunications and telemetry

Key Risks

In the Portsmouth Water Round 1 report, climate change risks were quantified using existing company procedures, as follows:

Risk = Consequence X Likelihood

The assessment of consequence and likelihood is quantitative, using a scoring methodology from 1 to 5 as available in Appendix C.

Risks were assessed in the Near (0-30 years), Medium (30-60) years and Long (60+ years) term.

The climate change risks forming the 'Priority areas for action' are organised according to their relevant risk mechanism, this format was used as the focus of the first round report was to integrate climate change into existing company bottom-up procedure for managing risk.

Portsmouth Water Risk Mechanisms:

Capital Planning: Capital Planning incorporates asset performance and failure data monitoring, decision making functions and investment planning

Drinking Water Safety Plan: The Drinking Water Safety Plan is the operational risk management tool for managing water quality risks from catchment to the customer tap.

Water Resources Management Planning and Drought Planning: Strategic risks to the supply/demand balance are managed through the Statutory Water Resources Management Plan process. The objective is to set out a twenty five year, least cost plan to ensure that a certain level of service is maintained. If the return period of an event exceeds the level of service then the Drought Plan will be implemented.

The more extreme risks to the supply/demand balance are managed through the statutory Drought Plan process. Drought Plans are produced on a three yearly cycle.

Resilience and Emergency Planning: Resilience and Emergency Planning is the process of reviewing the vulnerability of Company assets and operations to extreme events such as floods, heat waves and storms, and instigating measures (either capital or operational) where necessary.

The Emergency Plans cover any emergency event that may affect our customers, including weather events. The Plans are audited annually by Defra.

Capital Planning

Medium & Long Term:

- Accelerated asset deterioration of cast iron water mains from more extreme wetting and drying cycles and earth movement
- Accelerated asset deterioration of ductile iron, fibre reinforced concrete, PVC and steel water mains from more extreme wetting and drying cycles and earth movement

Drinking Water Safety Plan

Medium & Long Term:

- Lower river flows cause high contaminant concentrations
- Reduced cloud cover leads to increased biological growth in the river
- Higher temperatures cause increased biological and bacterial growth in river
- Lower river flows cause warmer water and increased biological and bacterial growth in river.

Long Term:

- Saline intrusion of potable water mains (metallic mains)
- Chemical supply chain disruption from regional heatwaves and floods

Water Resource Management Plan

Short Term:

- Increased summer abstraction by other (existing) catchment users due to reduced rainfall.

Medium & Long Term:

- Increased demand for water at peak from permanent population, driven by reduced rainfall and higher temperatures
- Increased demand from seasonal (tourist) population at peak
- Increased occurrence of drought
- Increased demand from net inward migration of retirement population
- Increased summer abstraction by other (existing) catchment users due to reduced rainfall
- Increase in agriculture leads to increase in abstraction by other catchment users

Resilience and Emergency Planning

Medium Term

- Increased flooding to source and treatment works from rivers and groundwater
- Increased flooding to pumping stations (raw and potable) and valves from rivers and groundwater
- Increased regional flooding from rivers and groundwater impedes routine mains repair

Long Term

- Road melt events impede treatment works access
- Increased interruptions to telecommunications and telemetry, driven by storminess.

The action plan: where we are in 2015

This section covers the 15 actions that came as a result of the Key Risks identified by the climate change risk assessment, the actions are referred to as the 'Climate Change Adaptation Action Plan'.

Commentary of 2011 Climate Change Action Plan

- The plan was devised on the understanding that Portsmouth Water through company actions, regulation and policy has developed robust mechanisms for monitoring risk and climate change should be intergrated within these mechanisms.
- Many of the climate change risks identified using UKCP09 will not have an effect on the region in the short term and so as a result, the action plan concerns itself with developing capacity to monitor and identify climate related trends and take the appropriate capital planning actions in due course.
- Many of the risks identified from the UKCP09 projections in the first round report are not new to the company, the projections suggest that the intensity and frequency rare climate events will increase over time.
- The plan is reflective of the company's asset structure, for example, the majority of the mechanical and electrical assets have an asset life of 15 years and so are frequently replaced and updated and so are not as exposed to long term climate risks.
- Longer life assets such as concrete service reservoir structures which may last 50+ years will require more climate change considerations in the shorter term.
- Portsmouth Waters activities have a direct consequence on Public Health and as such the company approach to risk is a precautious one.
- Whilst many of the actions have been implemented, some of the actions are on-going whilst some have a long term focus and so whilst they have been considered, they will have not been actioned. These are identified under each of the actions and are flagged with:
    - On going
    - Long term

Capital Planning Actions

Action 1: Incorporate Climate Change Risks into Investment Decision-Making

Action 2: Build Capacity within Asset Performance Modellers in understanding Climate Change Impacts

Action 3: Review the Case in AMP 6 for Incorporating Climate Change Impacts into Asset Deterioration Modelling

Action 4: Continued Engagement with Regional Planners and Decision Makers

Action 1

Incorporate Climate Change Risks into Investment Decision-Making

Status: Ongoing

Aim

To build long term capacity by investing in the data & modelling techniques, this will provide a base to enhance the Company's ability to monitor climate change risks and taking appropriate capital planning actions.

What have we done so far?

Above Ground Assets

Improving Data

- Commissioning of Water Research Centre WRc to prepare an asset centric data model to facilitate data collection for future asset management.
- Development of a new corporate 'Asset Centric' Works Assets Management system (WAMS). The model is used to facilitate data collection and produce life span models for asset management
- Improved site survey work to identify asset deterioration
- AMP 6 Flood Survey instigated in preparation for the AMP6 Business Plan. The methodology from the 2009 survey was applied to each site and in conjunction with updated flood maps obtained from the Environment Agency. For flood related capital projects see section '*Capital Investment: Demonstrating Resilience at Portsmouth Water, p29*).

Improving Data Analysis

- Asset centric life span model developed (MARM Model). The model is essentially a risk based cost benefit analysis tool that can be used for selecting long term strategies for above ground asset renewal to deal with asset deterioration and prevent service deterioration.
- Failure Modes Effect Analysis (FMEA) was introduced into project feasibility studies and cost benefit studies in AMP5.
- Introduction of risk based modelling with particular emphasis on the relationship of the quantification of risk in terms of asset failure impacting customer service.

Below Ground Assets

Improving Data

- Strategic change to pipe network performance data recorded on the Company's GIS for use with deterioration modelling
- Data cleansing of GIS system.
- Introduction of rigorous Quality Control Systems for data collection.

Improving Data Analysis

- Water Research Centre (WRc) was commissioned to create a mains deterioration model based on the Company's asset performance data in 2013 which contributed to establishing a mains renewal rate for AMP 6. The model identified that the principal mains showing deterioration are post 1945 in moderately or aggressive soil together with some PVC mains and will be prioritised for replacement.
- Risk based spatial mains renewal targeting methodology implemented in AMP 5 and procedures and produced the subsequent mains renewal programme.
- Use of network models to optimise renewal activities where appropriate.

Action

- Increase of mains replacement by no dig techniques which are less disruptive to customers, require less soil movement and reduce energy consumption. In AMP 6 installation rates of no dig techniques will increase from 3% to 20%.

What will we do in the next 5 years?

- The company has made considerable strides to developing systems for collecting and modelling asset data. In the next 5 years the company will continue to develop and make use of the above systems for capital decision making
- As the company continues to develop its asset management systems, the company will investigate integrating climate change effects into the decision making process (see Resilience Study under Action 3)

Action 2

Build Capacity within Asset Performance Modellers in understanding Climate Change Impacts

Status: Ongoing

Aim

To ensure those responsible for our capital plan have an understanding of how climate change factors could drive asset deterioration.

What have we done so far?

- Asset modellers have been briefed on UKCP09 Data

What will we do in the next 5 years?

- Provide planners with new climate change data as it becomes available
- Whilst the relevant members of the capital and investment teams have been briefed on UKCP09 data, the Company recognises that there needs to be further ongoing interaction in order to maintain momentum of the plan. The Climate Change representative in the Regulation Team will therefore hold annual meetings with the capital and investment team to review and discuss progress of the capital planning actions.

Action 3

Review the Case in AMP 6 for Incorporating Climate Change Impacts into Asset Deterioration Modelling

Status: Long-term

Aim

Following the steps taken in Action 1 to develop asset performance data, monitoring and modelling techniques; climate change effects will be considered for integration into the new systems.

What have we done so far?

- None – AMP 6 Action

What will we do in the next 5 years?

The information below outlines the company's Resilience Study project in which the findings will drive future capital planning actions. The project is motivated by increasing interest in resilience within the UK water industry and its regulators in recent years. This has arisen as a result of a more risk based approach to many external and environmental factors that impact upon resilience. As the intensity and frequency or rare weather events increases over time, this may contribute to a higher number of outages and so testing the network may become increasingly important.

Resilience Study (Operational Model Report)

- During AMP6 the Company proposes to appoint a consultant to undertake an Operational Resilience Study. The study will be a combination of a written report, that will identify potential areas of improvement, and a strategic operational model which using scenarios will test the network which will enable the Company to assess the impact on demand dependent on site outages, planned maintenance and operational events.

- The outcomes of the operational model are as follows:
    - Understand the interdependencies of the supply and distribution network
    - Allow for outages/planned maintenance to occur with the assurances that demand will be unaffected
    - To model different aspects of the network and to establish key areas/network transfers that may be required
    - To simulate the time periods of shortages based on demand
    - Assess the risks to the network dependent on outages/multiple events

Action 4

Continued Engagement with Local Authorities and Decision Makers

Status: Ongoing

Aim

To continue to engage with planners and decision makers on a number of topics in order to remain updated on the latest climate change information and recognise ongoing interdependencies. The company will also react to future rounds of flood management plans, shoreline management plans, spatial plans and flood mapping was also included in this heading,

What have we done so far?

- The Company continues to routinely engage with other planners, decision makers and stakeholders in the field of resilience, climate change, water resource management, spatial planning, pollution management and biodiversity.
- Latest flood maps used in AMP 6 Flood Survey. (See '*Capital Investment: Demonstrating Resilience at Portsmouth Water, p29*)

What will we do in the next 5 years?

- Continue to maintain and develop relationships with planners, decision makers and stakeholders and make use of the most up to date climate data.
- Ensure the most up to date flood maps are used in future flood management plans

Drinking Water Safety Planning Actions

Action 5: Incorporate the water quality findings of the climate change risk assessment into the Drinking Water Safety Plans

Action 5

Incorporate the water quality findings of the climate change risk assessment into the Drinking Water Safety Plans

Status: Ongoing

Aim

Water quality risks are managed operationally by the Water Quality team, capital investment may be instigated as a result of increasing levels of risk. Water quality risk is regulated by the DWI (Drinking Water Inspectorate) whilst economic investment is regulated by Ofwat.

The Water Quality team have a comprehensive understanding of the relationship between water quality and weather variables, such as impacts upon algal growth, bacterial growth, chlorine depletion, pollutant concentrations, turbidity events and process disruption.

The company will create an awareness of climate change drivers within the Water Quality team and identifying climate factors in the Drinking Water Safety Plans.

**The effects of deteriorating water quality are expected to be slow and manageable through the existing water quality risk mechanism.*

What have we done so far?

- Water Quality team have been briefed on UKCP09 Data
- Climate related factors have been flagged within the existing Drinking Water Safety Plan document

What will we do in the next 5 years?

- The Climate Change Representative in the Regulation Team with provide the Water Quality team with new climate change data as it becomes available
- The company recognises that there needs to be more interaction in order to maintain momentum of the action plan. The Climate Change representative in the Regulation Team will therefore hold annual meetings with the Water Quality team to review and discuss progress of the capital planning actions.

Resilience and Emergency Planning Actions

Action 6: Review Next Round of Environment Agency Flood Mapping as they become Available

Action 7: Incorporate emergency weather event risks into investment decision-making

Action 8: Incorporate heat wave and road melt events into Emergency Plans

Action 6

Review Next Round of Environment Agency Flood Mapping as they become Available

Status: Ongoing

Aim

The Company will be made aware of new developments in flood mapping through the regional resilience forum and standing data transfer agreements.

The Company incorporates the mapping on the business' GIS system and makes use of the findings.

What have we done so far?

- The most recent flood maps were used as a part of the AMP6 Flood Survey (For capital investment as a result of the survey see '*Capital Investment: Demonstrating Resilience at Portsmouth Water, p29*)
- Flood maps available on the company's GIS system

What will we do in the next 5 years?

- Continue to use and review new Environmental Agency Flood Maps as they become available

Action 7

Incorporate emergency weather event risks into investment decision-making

Status: Long-term

See Action 1 & Action 3

Action 8

Incorporate heat wave and road melt events into Emergency Plans

Status: Long-term

Aim

The Emergency Plans detail operational measures to adopt during an emergency event that affects customers. This includes extreme weather such as storms, floods and drought. As heatwaves may become much more frequent in the future, it is prudent to reflect these in the Emergency Plans.

The Emergency Plan is considered to be 'live' document and regularly updated as opposed to periodically reviewed ensuring the document always remains relevant and 'for use'. In the long term as road melts become an increasing threat, the plans will be updated and capital investment would be triggered if required.

What have we done so far?

- The members of the Investment team responsible for Emergency Plans have been briefed on UKCP09 data

What will we do in the next 5 years?

- The Climate Change representative in the Regulation Team will brief Emergency Planners on new climate change data as it becomes available in addition to annual update meetings to identify any arising climate related threats.

Water Resources Management Planning and Drought Planning Actions

Action 9: Continue to research climate change drivers of water demand at average and at peak times of the year

Action 10: Continued engagement with regional planners and decision makers on water demand issues

Action 11: Continued Engagement with other Stakeholders the Environment Agency on other Catchment Abstractors

Action 12: Research pressures on risk of breach of environmental flow requirements in water courses

Action 13: Continued research of impacts of climate change and seasonal aquifer characteristics

Action 14: Review Level of Service in the next water resources management planning cycle

Action 15: Assess impacts of climate change on 2011 Drought Plan

Action 9

Continue to research climate change drivers of water demand at average and at peak *times of the year*

&

Action 10

Continued engagement with regional planners and decision makers on water demand issues

Status: On-going

Aim

The Company undertakes research on the drivers of demand for water through a number of mechanisms including: Water UK, UKWIR projects, Club Projects, Company Data on Consumption Monitors & Distribution Input, Monitoring latest research from Environmental Agency and Waterwise.

**The effect of increasing demand is expected to be slow and manageable through the current Water Resource Management Planning cycle.*

What have we done so far?

- Continued to monitor drivers of water demand through the mechanisms listed above
- Expansion of the number of properties on the unmeasured consumption monitor in 2014 and 2015 to over 1,000 for a larger and more representative sample
- Introduction of more comprehensive Micro-components driven water use forecasts in line with Environmental Agency guidance for the Water Resource

Management Plan 2014 which has given a better understanding of Household customer use and provided data that can be used to model dry year scenarios.

- Club project to engage consultant Experian to conduct 25 year properties and population forecast

What will we do in the next 5 years?

- Comply with future Environmental Agency forecasting methodologies in the Water Resource Management Plan 2019
- Further expansion of consumption monitor if appropriate
- Engage in club projects were appropriate
- Continue to monitor demand related research and Environmental Agency guidance
- Continue to monitor current UKWIR investigation into improved methods for capturing demand uncertainty such as stochastic models

Action 11

Continued Engagement with other Stakeholders the Environment Agency on other Catchment Abstractors

Status: Ongoing

Aim

The Company expects hotter, drier summers will lead to increased abstraction by other catchment operators including abstractors who may not be licensed. There is uncertainty over the impact that other abstractors would have in drought conditions should their own water resources deteriorate and require supply from Portsmouth Water as this is not specifically accounted for in the Water Resource Management Plan. Uncertainty such as this is captured in the plan as 'headroom'

Increased sunlight (reduced cover) may also lead to an increase in agriculture and horticulture in the region, and associated abstractions.

The Company will continue engagement with the Environment Agency on this risk and will collaborate with other water companies through Water Resources in the South East and Water UK.

What have we done so far?

- Followed EA methodologies on capturing headroom in the Water Resource Management Plan 2014
- Continued engagement with Water Resources in the South East and Water UK on regional risks

What will we do in the next 5 years?

- Follow EA methodologies for capturing demand & supply uncertainty in the 2019 Water Resource Management Plan, this is currently under review and Portsmouth Water will continue to monitor and contribute through the relevant networks

Action 12

Research pressures on risk of breach of environmental flow requirements in water courses

Status: Ongoing

Aim

During AMP 5 the Company intended to undertake investigations related to the Habitats Regulations and the Water Framework Directive on the impact of abstraction on ecology. The investigation would include hydrological modelling work enabling increased understanding of the company effect on environmental flows.

This impact must be understood on water available for use and incorporated into future water resource management planning cycles.

What have we done so far?

- Commissioned AMEC to conduct assess the impact of the company's abstractions on the environment. As a result of the finding from the study, the company commissioned river augmentation project and made licence adjustments.
- The resulting licence adjustments were factored in the 'Sustainability Reductions' section of the 25 year Water Resource Management Plan.

What will we do in the next 5 years?

- Continue to engage with the Environmental Agency sustainability impacts on abstraction licences. These will form a part of the Water Resources Management Plan 2019

Action 13

Continued research of impacts of climate change and seasonal aquifer characteristics

Status: Ongoing

Aim

Work with the Environment Agency and other stakeholders to understand how climate change will impact aquifer recharge and groundwater levels throughout the year. These risks would be factored for in subsequent Water Resource Management plans.

What have we done so far?

- The company has worked to integrate UKCP09 data into the Water Resource Management Plan 2014. The company commissioned consultant URS with the assistance of HR Wallingford to study the impacts of climate change including:
  - A vulnerability study of the region, the findings determined Portsmouth Water to be at medium risk
  - 10,000 UKCP09 projections were used to mode a subset of 100 results on Surface Water and Ground Water to account for uncertainty. The combined impact of the models on Deployable Output in the medium term (by 2035) under and average demand scenario suggests a 1.9 Ml/d average reduction and 2.6 Ml/d at peak
  - The combined effects surface and ground water levels on deployable output extrapolated over the 25 year planning period

- The effects of Climate Change were then accounted for in the 'Headroom' of the supply demand balance in the 2014 Water Resource Management Plan

What will we do in the next 5 years?

- Continue to use the most recent climate change predictions when calculating climate effects on groundwater and source yield monitoring for the Water Resource Management Plan 2019

Action 14

Review Level of Service in the next water resources management planning cycle

Status: Long-term

Aim

The Water Resource Management Plan anticipates that there may be infrequent occasions when demands are likely to exceed the availability of supply, these are likely to occur during periods of drought and restrictions must be applied on water use. The frequency at which these events occur is referred to as 'a level of service' and it is reviewed in each water resources planning cycle. Levels of service are set by the Portsmouth Water Board and backed by customer research on 'willingness to pay', this will become increasingly important when considering the impacts of climate change.

The Company will make use of drought modelling data produced through UKWIR projects to support levels of service.

What have we done so far?

- The Company has maintained the existing 1-in-20 year event 'level of service' at which temporary use bans are required in the 2014 Water Resource Management Plan.

What will we do in the next 5 years?

- Review the levels of service in Water Resource Management Plan 2019

Action 15

Assess impacts of climate change on 2011 Drought Plan

Status: Long-term

Aim

Climate change is expected to increase the occurrence of drought events, both minor and severe. The Company is particularly vulnerable to multiyear droughts as the Company has no water storage assets.

The impacts of climate change on drought events and drought management will therefore be reviewed following the production of the 2011 Drought Plan.

The Company also will make use of drought modelling data produced through UKWIR projects.

What have we done so far?

- Included within the Drought Plan 2011 methodology the company was required to calculate deployable output at each level of service. The model used to calculate river flows was based on the URS CATCHMOD model which factors in climate change, see Action 13 for more details.

What will we do in the next 5 years?

- Continue to follow Environmental Agency guidance and methodologies for defining levels of service and calculating Deployable Output in the next round of Drought Planning. For example it is currently proposed that Drought Plans are integrated with Water Resource Management Plans in 2019. There is also currently a research project being carried out by independent consultants and managed by UKWIR to investigate methods for capturing uncertainties such as climate change and building them into stochastic demand and supply models.
- Portsmouth Water will continue to engage with upcoming UKWIR research projects for the Water Resource Management Plan 2019.

Other

1. Energy Consumption

2. Carbon Reduction

3. Water Efficiency

4. Leakage

- In 2012 Portsmouth Water's sister company Brockhampton Holdings installed solar power cells at several sites reducing the Company's carbon footprint.
- The Company plans to increase the proportion of electricity used from renewable sources by 10% during AMP6
- Portsmouth Water in May 2015 is due to trial a new intelligent pump management system which can bring energy savings of up to 30%, increase efficiency and reduce carbon emissions. If the trials are successful the company will consider investment in AMP7
- Through timing of pumping and monitoring of usage the company in 2012/13 was able to reduce electricity costs by 5.6%
- The company will comply with 2015 ESOS (Energy Savings Opportunity Scheme) audit of a least 90% of total energy consumption and will make use of the findings.

- During AMP 5 the Company had an Ofwat Service Base Efficiency Target (SBWE) of 0.29 Ml/d representing a saving of 1 litre per property per day. Through the Company's water efficiency program the company was able to exceed the Ofwat efficiency target and for the period 2010-2015 the company has achieved an average saving of 0.30 Ml/d.
- In AMP 5 (2010-2015) Ofwat set a leakage target of 30.0 Ml/d, in 2014/15 the Company remains on track to reach this target.

Capital Investment: Demonstrating Resilience at Portsmouth Water

The prior section outlines how the company is building climate change adaptation capacity into the existing 4 risk mechanisms, the follow section illustrates;

a) How the company has been able to mitigate climate risks during AMP5 and AMP6
b) How the existing risk mechanisms build long term resilience for the company and its customers

It is important to note that whilst the projects below are related to climate factors, they are not a direct product of the climate change adaptation plan but risks the company would seek to mitigate. The climate change adaptation plan is a long term plan for building further capacity for climate factors as risk increases over time.

AMP 5

2010-2015

- Flood defences installed at 4 high risk sites following the AMP 5 flood survey, these sites were considered to be at a likely risk of a 1-in-100 year fluvial flood or a 1-in-200 coastal flood
- Covered the clarifiers at the Raw Water Storage Reservoir at the River Itchen Treatment Works reducing the risk of Trihalomethanes (THMs) and restriction of algal growth by exclusion of sunlight
- Rigid steel structure built to prevent sunlight increasing algal growth and to control water temperature at Highwood Reservoir.
- Structure was constructed over the previously open aired rapid gravity filters to offer a level of protection against potential raw water contamination

AMP 6

2015-2020

- Ultra Violet Disinfection works to be built at two water treatment sites to mitigate the increased risk of Cryptosporidium
- The company will continue to proactively worked with local farmers to improve the quality of raw water in the water catchment, targeting the 5 sites experiencing increasing nitrate levels
- Improvement of disinfection to meet Water Quality Standards
- Flood defences to be installed at 2 high risk sites following AMP 6 flood survey.

- Included within the Resiliency Study (Action 3), the company will investigate duelling a strategically significant main to increase resilience in the event of a major pipe burst.
- The Company's response to a loss of supply is to deploy alternative water in the form of static tanks and bowsers. In AMP6 the company will purchase 12 additional Arlington tanks to further increase the Company's level of resilience without the need for mutual aid
- Approximately 80% of the Company's water treatment works and pumping stations have stand-by generation to provide an alternate electrical supply in the event of a power outage, 60% of which require manual intervention. Included within the Resilience Study will be an investigation into the automation of standby generation.

Barriers, Opportunities and Interdependencies

Barriers

Cost: As a part of the investment submission to Ofwat the company must demonstrate using customer research that the business plan meets customer's expectancies and 'willingness to pay'. Many of the climate change factors are considered to be long term and as such customers are unlikely to want to pay for significant investment in the short term for an increased cost of water.

Regulation & Regulative Structure: The current 5 year rolling planning cycles allow for short to medium term adaptation and flexibility, however it is not as suited to long term drivers such as Climate Change. Capital investment requires significant justification to the regulator however the wide uncertainty of the UKCP09 does not provide this. For example Portsmouth Water currently has no raw water storage, increasing demand and the reduced availability of water in the long term beyond the 25 year water resource planning scope may require greater raw water capacity to be constructed such as a reservoir, however the company would not be able to justify this with the UKCP09 data. It is likely that such investment would be triggered as demand increases over time, this risk is captured within the Water Resource Management Plan. There is also potentially a need for the regulator to define the level of resilience to climate change that water companies should meet setting clear parameters of when to invest.

Limitations of UKCP09 data: The Company has used UKCP09 data for the purposes of Climate Change adaptation reporting and Water Resource Management Planning (WRMP). For the climate adaptation plan the data has been of use for providing an array of climate change projections which have been used for our top level vulnerability assessment and to create and communicate an awareness of future climate change effects among decision makers. The data however is difficult to translate into real terms at an operational level either because of the availability of data, uncertainty or the scale of processing required. For example whilst the company has used consultants to model UKCP09 predictions into ground water and river flow scenarios for the WRMP14, the UKCP09 data itself has a wide degree of uncertainty initially which is magnified once applied to other factors such as hydrological modelling. Additionally whilst probabilistic long term averages of climate variables are available, broad assumptions must be made on their effects on a number of factors including socio-economic change, population migration, asset performance & resilience, water quality occurrence of drought and the thresholds at which further asset investment should be made and to what extent – this data is unavailable to the company and to model such variables would take significant investment, disproportionate to risks that can be mitigated in the short and medium term.

External Awareness: Arguably there is some public confusion over the definitions of climate change, whilst there is an awareness of climate change, its effects and certainty at a regional level and what it means to customers in real terms is unclear. Whilst climate change remains an enigma it may prove difficult for customer to take and impact on bills in order to invest in long term climate change adaptation.

Internal Awareness: Since the introduction of the Climate Change Adaptation Plan one of the challenges the company has found is maintaining momentum of the plan. This again is likely due to the long term nature of climate change and the level of uncertainty. Additionally as the structure of the company changes over time, responsibility over sections of the plan have become less clear. To overcome this the Climate Change Representative in the regulation department will hold annual meeting with the relevant heads of department to discuss the action plan progression and climate change updates.

Opportunities

Few opportunities have been identified as a result of the UKCP09 climate change projections, the following list could be provide a benefit to the company however there is a high degree of uncertainty.

- Increased winter rainfall could lead to greater water available for use in the summer months
- Increase soil fracturing may lead to accelerated aquifer recharge
- Although the company currently has no raw water storage, in the long term if the company had builds this capacity, winter rainfall could be stored for increasing summer demand
- Warmer winters could lead to a reduction in water main bursts associated with cold weather and earth movement

Interdependencies

In the first round report the company gained a greater understanding of the climate change effects on other infrastructures that the company depend upon in order to maintain its service such as energy, transport and ICT. The first round report recognises the dependence that the company has on these other industries outside of the companies control and so the importance for other sectors to adapt their infrastructure. Arguably there is a need for a greater consideration at an industry level, perhaps driven by the regulator or a government body to make an assessment of how water companies are impacted by other sectors that companies are so dependent on such as energy, what those industries are doing to build resilience and how cross sector solutions can be developed into operational plans.

Re-evaluating risk in 2015

The 2011 first round report produced an extensive quantification of different climate change factors on each of Portsmouth Water's business functions, these tables were then reduced into smaller 'Priority Risks'. The long term nature of climate change means that the risks identified in the first round are unlikely to have changed since 2011, accordingly in response to second round of reporting, the Company has only re-evaluated the 'Priority Risks' using the first round methodology of which a summary is included below, for the updated risk tables please see Appendix B. Whilst some changes are a result of risk mitigation or new learnings, during the second round evaluation some risks were identified as having high 'consequence' or 'likelihood' scores leading to disproportionately large overall risk scores, these have also been adjusted.

It is noted that UKCP09 data was used in the Round 1 report, no new UKCIP climate projections are currently available and as such underlying climate assumptions have not changed.

Risk Score Reduced:

- The consequence score of 'Saline intrusion of potable water mains' has been reduced as on review this is only possible once there has been a burst and in such an event this would be mitigated with standard operational procedures such as mains repair and post repair flushing
- Saline intrusion of service reservoirs has been removed and this is highly unlikely, Portsmouth Water's service reservoirs all sit on high ground, the lowest reservoir sits at 40AoD whiles the remaining reservoirs all sit above 85AoD.
- Algal growth in rapid gravity filters and clarifiers remains at a low risk score of 1, in the short to medium term this is even more unlikely as the RGFs have been covered. The risk remains in the matrix in the long term as temperature rises there may be a small risk that bacterial growth may increase, however this can be mitigated through treatment processes.
- The consequence score for the accelerated asset deterioration of cast iron water mains from more extreme wetting and drying cycles and earth movement has been reduced. Whilst Cast Iron mains form a significate percentage of the network, unlike other materials it is easier to identify bursts and assuming an increased burst rate, the mains would be replaced as a part of the ongoing mains renewal program. An increase in efficiencies such as no dig techniques in the future could also mean greater lengths of replacement would be more viable.
- The risks under 'Water resources' when reviewed were inconsistent with the other risk mechanism matrixes as they did not fully account for of uncertainty or the level at which the risks can be managed through existing operational activity, as a result risk scores have been reduced for the following areas:
    - ***1**. Increased demand for water at peak from permanent population, driven by reduced rainfall and higher temperatures*
    - ***2**. Increased demand from seasonal (tourist) population at peak*
    - ***3**. Increased occurrence of drought*
    - ***4**. Increased demand from net inward migration of retirement population*
    - ***5**. Increased risk of breach of environmental flow requirements in water courses, reducing reliability of sources for public water supply*
    - ***6**. Increased summer abstraction by other (existing) catchment users due to reduced rainfall*
    - ***7**. Increase in agriculture leads to increase in abstraction by other catchment users*

***8**. Saline intrusion of borehole sources*

Risk score increased:

- The nature of the chalk aquifer in the region means the company is vulnerable to turbidity events. This risk has been demonstrated by increased detection of cryptosporidium at two sources close to each other and both sites have experienced outages as a result. Likelihood scores have therefore increased for this risk. We continue to closely monitor and review our water quality and as a result of increased cryptosporidium detection, more sophisticated treatment will be installed at the two works in AMP 6 to mitigate the current risk.

Summary

Climate Change is expected to bring future challenges to the company, although many of the risks presented are not new, they are climate related risks that the company already control through operational procedures, risk mechanisms and regulatory commitments. It is expected however that rarer events linked with climate will increase in frequency and intensity resulting in higher levels of exposure to risk over time, these are risks can be broadly placed into six categories; *Sufficiency of Water Available in Existing Sources, Increasing and Changing Demand Patterns for Water, Quality of Water Available for Abstraction, Performance of Assets, Resilience of Assets and Sea Level Rise*. Increasing levels of risks over time emphasise the importance of creating awareness of climate change risks, monitoring critical thresholds, engaging with networks & third parties and making use of available data – it is these elements that will allow the company to build future capacity for slower onset climate risk and form the basis of our adaptation plan.

The review of the Portsmouth Water Adaptation Plan has shown that progress has been made in building resilience to climate change, an area of increasing importance in the water industry. The company has made particular progress in the development of how data is used to monitor risk and plan investment. The company has demonstrated how shorter term risks associated with climate change such as flooding and water quality issued have and will be mitigated through capital investment, not as a direct result of the adaptation plan but risks the company already looks to reduce.

As the adaptation plan moves forward, the company must continue to improve the way in which climate change data is shared within the company and integrated within business planning decisions. In order to maintain the momentum of the adaptation plan, responsibility for the plan has therefore been centralised within the regulation department whom will hold responsibility for sharing new findings and monitor the progress of the adaptation plan on an annual basis.

As a part of the adaptation process, the company has also developed a greater understanding of the barriers to adaptation and interdependencies with other infrastructures. Arguably the underlying factor behind the barriers to change is the uncertainty and complexity associated with climate change, how it will affect the water industry in real terms and to what extent should it be used to justify long term capital investment. It is for such reasons that it is important the top-level adaptation plan is in place to build capacity for future adaptation and understand how climate risk are managed within the existing company mechanisms to mitigate climate risk in due course.

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