# SRN-DDR-041: Climate Resilience
# Enhancement Cost Evidence Case

28th August 2024
Version 1.0

from Southern Water

# 1. Introduction

This document sets out the wastewater and water schemes we plan to deliver through funds available through Ofwat's climate resilience uplift mechanism.

Since our October submission of our Power, Flooding and Heat Stress operational resilience enhancement business cases and the draft determination outcome we have reassessed our priority investment areas and developed additional evidence to address the feedback points received and support our case to make these investments in AMP8.

The purpose of this document is to provide:

- information on the wastewater and water investments we are proposing to make using the climate resilience uplift mechanism; and
- supporting information and additional evidence to respond to the feedback and comments our plans received during the draft determination deep dives.

This document should be considered in alignment with SRN49 Power resilience, SRN51 – Heat stress resilience and SRN52 Flooding. It contains additional information, evidence and updates on the investment decisions we have made following our draft determination. It builds on our October submission and responses to our power and flooding queries (OFW-OBQ-SRN-211 and OFW-OBQ-SRN-182) but is not designed to repeat all aspects of the original business cases.

# 2. The issue

In the draft determination and deep dive into our operational resilience enhancement business cases Ofwat said:

*"For Draft Determination, we make no specific enhancement allowance for flood resilience expenditure requests.* ***Impacts of climate change are sector wide. To address this, we propose a sector wide enhancement uplift (based on 0.7% of base allowances) for companies to prioritise their biggest climate related risks****… We request that all companies* ***set out what they will deliver for the additional funding in their responses to the draft determination****…* ***This should, as a minimum, address additional flood and power resilience requirements from climate change."***

# 3. Our Response

Climate change is driven by changes in mean global temperature. Since 1950, global mean temperatures have risen by around 1°C and are projected to increase by 2 to 4°C by 2100. In our region, the resulting impacts of the changing weather patterns caused by these changes fall into four main areas:

1. Increased temperature and more extreme variation in temperature;
2. Less rainfall or longer dry periods (drought);
3. More rainfall, or more intense rainfall (increased storminess); and
4. Sea level rise.

As we described in our October submission, the drivers for enhancement investment in our power systems at our wastewater sites are to mitigate the impact power supply interruptions have on our operations and reduce the number of Category 1-3 pollution incidents we incur which harm the environment and impact our customers.

The two main climate risk drivers for the need for this investment are the:
- Increasing frequency and severity of storm events that result in power supply interruptions; and
- Increasing risk of higher temperatures on our power system assets as a result of climate change.

Specifically**, in addition to our previous submission and associated query responses** provided to date, we have carried out climate change adaptation risk assessments and research that has identified specific vulnerability of power system assets to heat stress events. As illustrated throughout this document, this is an increasing risk which is impacting the South East more severely than other parts of the UK.

After reviewing the guidance on the climate resilience uplift mechanism funding provided at draft determination stage, we have reassessed and re-prioritised the investments in our flooding, heat stress and power operational resilience schemes to take forward through this mechanism.

As part of our draft determination response, we are **now requesting total of £28.9m** through the climate resilience uplift mechanism in AMP8. **A reduction of £15.3m from our original request** of £44.2m for these schemes.

Our request for **£28.9m** is based on:
- **£21.5m for wastewater** climate resilience improvements in power and flooding resilience solutions; and
- **£7.4m for water** climate resilience improvements in power and heat stress solutions.

We understand this request is larger than the indicative 0.7% base expenditure Ofwat suggested in the draft determination. We understand that the 0.7% base expenditure value was based on the median costs submitted as part of the water sectors business plan submissions as opposed to an evidence-based methodology,

We strongly believe, coupled with the additional evidence provided in our response, that despite it being larger than 0.7% of our base expenditure, we need the revised level of investment being requested to improve the resilience of our critical sites against the climate risks we are facing. This allowance will allow us to build a combination of resistance, redundancy and reliability at a number of our most important sites to protect our customers and the environment against worsening climate risks and impacts.

For wastewater, the priority would be the additional power resilience funding due to the impact this has in terms of pollution. The proposed sites for investment have the potential for serious pollution incidents in sensitive bathing water areas. The size and location of these sites mean we need to remove these [redacted]. Although we have enhanced our detection and response approach this does not provide the level of resilience expected from our environmental stakeholders and local communities.

For water, the priority is to build redundancy in our power systems at sites where we have experienced large numbers of power faults by installing fixed standby generators. These generators will be rated to operate the entire site when required due to interruptions to mains power supplies from our DNOs. Additionally, we need to protect our sites against the impact of increasing temperatures and the effects of climate driven heat stress, so are proposing to progress with our investment in two heat stress schemes at two important Water Supply Works.

The remainder of this document is set out as follows:
- Summary of how our operational resilience investment plans have changed since October;

- Additional detail on the specific climate risks impacting our wastewater and water operations;
- Additional information on our updated investment plan and evidence to respond to the draft determination deep dive feedback for our wastewater and water schemes.

# 4. Summary of changes to our climate-related operational resilience investment

Since October, across our power, flooding and heat stress operational resilience schemes, we have carried out activities to mature our scope, scheme design and costings. Alongside the feedback and guidance received at draft determinations, we have had to re-assess our investment plan and make difficult decisions on which schemes to prioritise in AMP8 and develop supporting evidence around the need, optioneering and cost efficiency of our updated plan.

## 4.1 Changes to our wastewater investment plans

Across our power, flooding and heat stress operational resilience plans for wastewater, **our plan has reduced by £11.6m** through:

- prioritising our power resilience schemes in the River Stour catchment and Eastbourne and our flooding schemes; and
- de-prioritising our wastewater standby generator and heat stress schemes for AMP8.

| Ref. | Scheme Type | Total AMP 8 Oct 2023 | Ofwat challenge | Allowed at DD | Our response Aug 2024 | Change | Total |
|---|---|---|---|---|---|---|---|
| Progressed | Power – River Stour Catchment Schemes | £21.0m | 100% | £0m | Request 7 of 10 sites to progress through climate resilience uplift mechanism | -£4.3m | £16.7m |
| | Flooding | £5.4m | | £0m | Request all 6 sites to progress through climate resilience uplift mechanism | -£0.6m | £4.8m |
| Sub-Total | | £26.4m | - | £0m | - | -£4.9m | £21.5m |
| Not Progressed | Power – Standby Generators | £5.9m | 100% | £0m | No challenge to DD outcome, risks and impacts to be monitored during AMP8. | -£5.9m | £0m |
| | Heat Stress | £5.7m | 100% | £0m | | -£5.7m | £0m |
| Sub-Total | | £11.6m | - | -£0m | - | -£11.6m | £0m |

**Table 1: Overview of the changes in our wastewater investment plans compared to our October submission and draft determination outcome**

Detail and rationale on the specific changes for these schemes, alongside supporting evidence is provided in in this document

## 4.2 Changes to our water investment plans

Across our power and heat stress operational resilience plans for water, **our plan has increased by £1.1m** through a combination of:

- increased understanding of the costs associated with the works required to install fixed standby generators at each site; and
- an associated re-prioritisation of site investment (water supply works and booster stations) to minimise total cost increases for the programme.

We still intend to deliver our 2 heat stress water solutions through the climate resilience uplift mechanism, to help prepare some of our critical sites to be able to reliably operate under the higher ambient temperatures that we are seeing through the effects of climate change.

These solutions have been prioritised using several criteria that are explained throughout the rest of this document. They are designed to make our operations more resilient to the impacts of asset heat stress on our and the Distribution Network Operator (DNO)-owned assets through the installation of more redundancy in our most critical water sites which do not currently have fixed standby generators installed.

The planned investment has also been designed to maximise the use of the water allocation for the climate resilience uplift mechanism.

| Ref. | Scheme Type | Total AMP 8 Oct 2023 | Ofwat challenge | Allowed at DD | Our response Aug 2024 | Change | Total |
|---|---|---|---|---|---|---|---|
| Progressed | Heat Stress | £1.5m | 100% | £0m | Request all 2 sites to progress through climate resilience uplift mechanism | - | £1.5m |
| | Power – Standby Generators | £4.8m | 100% | £0m | Request 5 of 9 sites to progress through climate resilience uplift mechanism | +£1.1m | £5.9m |
| Sub-Total | | £6.3m | - | £0m | - | +£1.1m s | £7.4m |

**Table 2: Overview of the changes in our water investment plans compared to our October submission and draft determination outcome**

Detail and rationale on the specific changes for these schemes, alongside supporting evidence is provided in this document

# 5. Additional evidence on our key climate-related risks impacting operational resilience

## 5.1 Increasing risk outside of our control and worsening climatic position – increasing temperatures

From the deep dive feedback received across our power and heat stress operational resilience enhancement business cases we note the concerns raised about the amount of information and evidence we provided to describe the increasing climate-related risks we are facing and how our solutions are designed to mitigate and minimise the operational impact of these risks materialising.

**The following section is designed to provide additional evidence and information to respond to concerns over the need for and the link to worsening climate risks. It is applicable to the following elements of our revised plan:**

- **Wastewater power schemes – River Stour catchment and Eastbourne WTW**
- **Water power standby generator schemes**
- **Water heat stress schemes.**

### *Asset Heat Stress – climate risks posed by increased temperatures*

As part of our climate change risk assessment for PR24 investment planning work we assessed UKCP18 extreme heat projections to understand the resilience risks associated with heat stress on our critical assets. This additional information is particularly relevant to our Heat Stress and Power Resilience schemes in the River Stour catchment where we are investing directly to reduce the level of residual risk posed to our operations from asset heat stress. It is also pertinent to supporting our need to invest in fixed standby generators for our critical water sites to provide additional redundancy.

### Asset Heat Stress risk assessment methodology and datasets

Our asset heat stress risk assessment considered how climate change could potentially increase the risk of heat stress to our assets due to predicted increases in the frequency and magnitude of extreme high temperatures over coming decades.

The assessment used the following datasets:

- UKCP18 Extreme Temperature Grid: this showed predicted maximum summer (i.e. June to August) air temperature for the year 2070 for a 1-in-100-year return period event, using a baseline period of 1981 to 2000 for Representative Concentration Pathway (RCP) 8.5. Note: it was not possible to include all assets within this assessment given that a small number were in areas not covered by this Extreme Temperature Grid (Appendix B);
- Ordinance Survey Terrain 50 dataset: this was used to identify whether each asset was located on a north or south facing slope. Assets on south facing slopes are potentially more susceptible to heat stress; and
- Forestry Commission National Forest Inventory (Woodland England) & Historic England Park & Gardens layers: these layers were used to determine which assets are likely to benefit from shading. Assets not benefitting from shading are potentially more susceptible to heat stress.

Each type of asset was first assigned a ‘Heat Stress Susceptibility’ score based on asset type. The ‘Heat Stress Susceptibility’ score ranged from 1 to 5 and recognised that certain types of assets would be more susceptible to heat stress than others. **For example, the risk assessment results found that our water supply and wastewater treatment works contain a wide variety of high and low voltage assets as part of their power supply and command and control systems; this infrastructure is potentially most vulnerable to heat stress. These assets were subsequently assigned the highest ‘Heat Stress Susceptibility’ score of 5.**

Our asset heat stress risk assessment considered the following climate change scenarios and future time periods.

The heat stress assessment considered a future **time horizon of 2070** and used extreme **summer temperature data from Representative Concentration Pathway (RCP) 8.5.**

The result of this assessment is illustrated in Figure 1 that shows maximum air temperatures across our operational region as being between 38-40 degrees Celsius during summer conditions by 2070.

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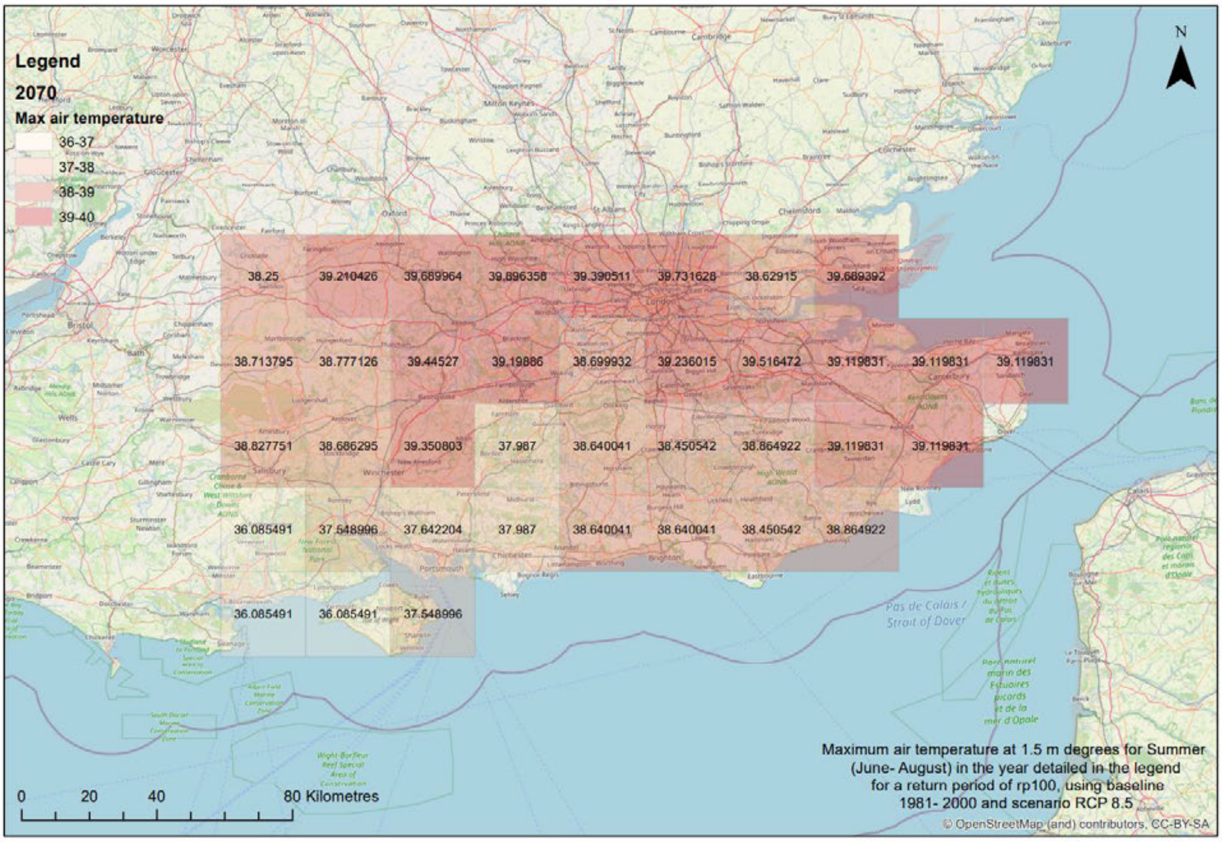


**Figure 1: Maximum forecast air temperature for South East England in 2070 under RCP 8.5**

We need to make interventions in our operational asset base to allow us to function and operate under these worsening climatic conditions. The selected UKCP18, CCC report (2021) as presented in our Climate Change Adaptation Report 2021 stated the following projections around average annual temperature rises shown in Table 3.

| Average annual temperature rise metrics | 2°C warming | 4 °C warming |
|---|---|---|
| UK annual average temperature increases (2080) | 0.7°C | 3.0°C |
| Average summer temperature increase (South East) | 3-4°C | 4-6 °C |
| UK heatwave (like 2018) (2100) | 50% chance each year | 90% chance each year |

**Table 3: Average annual temperature risk metric under UKCP18 scenarios from our Climate Change Adaptation Report (2021) 1**

This insight from the UKCP18 data supports the understanding that the South East is facing a significant increase in annual temperatures because of climate change which poses a significant risk to our assets.

Additionally, as seen through our climate change research and scenario modelling described in the section above, our power infrastructure at critical wastewater treatment and water supply works are some of the most susceptible to the risks posed by increasing temperatures and heat stress.

## Climate risks associated with our DNOs

While our analysis on asset heat stress risk has focussed on the assets and sites we own, similar impacts will be felt by the Distribution Network Operators who provide mains power supplies to our sites. Across our operational region, our mains power is supplied by UKPN and SSEN.

Both UKPN and SSEN carry out climate change adaptation risk assessments in line with the method developed and followed by their trade association, the Energy Networks Association (ENA). This means that the energy network organisations identify the same climate related risk and assess their impact on their own organisations. This provides a consistent baseline to measure risk against in an environment where the same types of electrical assets are being assessed.

From their published business planning documentation around climate change adaptation, there is corroborating evidence of the increasing risks associated with higher average temperatures and other flooding risks that could impact our operations. This strengthens our need to make this investment in power, flooding and heat stress.

[1] https://www.southernwater.co.uk/about-us/environmental-performance/protecting-and-improving-our-environment/climate-change-adaptation-report/

### *DNO Temperature/Heat Stress Risk Descriptions*[2]

The ENA and each DNO defines the following temperature climate risk descriptions that align with our associated asset health risks.

Descriptions taken verbatim from SSEN's Climate Change Adaptation Report (2021):

- "**AR1 Temperature** - Overhead line conductors affected by temperature rise Thermal expansion of conductors throughout the year is a design consideration for overhead lines. Supporting structures are designed to account for conductor sag to ensure statutory ground to conductor clearance is maintained. Lines are currently designed using three temperature zones, Winter, Spring/Autumn and Summer. Where these lines are exposed to temperatures considered extreme by UK standards, and where the frequency and duration of these events increases, it is possible that sag will exceed the current overhead line design parameters. This could lead to an increasing number of occasions where conductor clearance limits are compromised. Increasing temperatures also reduces the capacity of the conductors and constrains the network as a consequence. Conductors are designed to operate at a maximum core temperature corresponding to a specific ambient temperature and load (current) rating. Heat produced in the core of the overhead line is due to the electric load it is carrying. As the ambient air temperature increases the core temperature increases as does the resistance within the conductor culminating in a reduction in its current (load) rating or an exceedance of its design temperature. The advent of higher usage of electricity in the Summer could result in lines needing to be upgraded to account for the higher load and ambient temperatures"
- **"AR4 Temperature** - Underground cable systems affected by increase in ground temperature Increasing ambient temperatures can increase the ground temperature in which the cables are installed. Cables are designed to operate up to a design core temperature corresponding to a specific ground temperature and load (current) rating. Heat produced in the core of the cable is due to the electric current it is carrying. As the ground temperature increases less heat can be conducted from the cable. The effect is to reduce the current (load) carrying capacity of the cable"
- **"AR7 Temperature** – Transformers affected by temperature rise Transformers are designed to operate within particular temperature parameters and are assigned a maximum operating temperature for a given ambient temperature and load current. As air temperature increases, for the same load current, the operating temperature can exceed the maximum operating temperature of the transformer. Such situations can causing overheating of the transformer reducing capacity and life expectancy and, in extreme cases, cause failure of the unit."
- **"AR8 Temperature** - Transformers affected by urban heat islands and coincident air conditioning demand Localised build-up of heat, particularly in city environments, will lead to increased demand from air-conditioning and ventilation unit operation; some network operators are now seeing very little difference between Summer and Winter demand. Traditionally Summer was always the season of reduced electricity usage and could be exploited when rating a transformer, which is normally rated for Winter demands and lower ambient temperature. Increased Summer demand can overheat the transformer reducing capacity and life expectancy and, in extreme cases, cause failure of the unit."

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[2] SSEN Climate Change Adaptation Report - Third Round, December 2021 - [Climate change adaptation reports - SSEN]

- **“AR9 Temperature -** Switchgear affected by temperature rise Increasing temperature impacts all plant and equipment and increases will impact on switchgear by reducing its capacity, or in extreme cases lead to the switchgear tripping resulting in loss of supply or operating incorrectly and damaging the network. Prolonged periods of hot weather will increase the temperature inside switch rooms and could exceed the maximum optimum operating parameter for the switchgear increasing the potential for faults or mal-operation of protective devices. Switchgear is designed to international standards, however, there are recorded days where switch room ambient temperatures have exceeded the operational maximum of the switchgear. This may result in substations requiring air conditioning/chilling to be installed”

## Overview of key climate risks and impacts identified in UKPN’s Climate Adaptation Report 2021[3]

In 2021 UKPN released an updated climate adaptation report to reflect the level of risks associated with the newer UKCP18 data. Within its 15 high level risks, 6 are linked to electrical asset risks because of increasing temperatures. This is similar to our own research.

Figure 2 contains the updated risk scores under a Do-Nothing baseline scenario for a 2050 timescale. The results show a significant increase in the asset risks, from Low-risk scores (2 or 3) to Medium-risk scores (12), indicating an increased likelihood and/or impact of these risks materialising in those timeframes.

UKPN’s investment plans include implementing a variety of measures to mitigate these risks during ED2, and with these measures applied they achieve risk scores of between 4 and 6. This demonstrates our need to deliver similar investment in our power assets, particularly transformers, to increase our resilience to heat stress and other climate-related risks.

[3] UKPN Climate Change Adaptation Report 2021 - UK Power Networks Report (umbraco.io)

**UKPN Climate Change Adaptation Report**

UK Power Networks
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*Table 4 UKPN Priority Risks Scores*

| | UKPN APR2 View | | | UKPN Current View | | | |
|---|---|---|---|---|---|---|---|
| Risk | 2020 | 2050 | 2080 | Present Baseline 2021 | Baseline 2050 (Do Nothing) | Improved 2050 (based on RIIO-ED2+ plans) | Targeted improvement 2100 (ED2++) |
| AR1 Temperature - Overhead line conductors affected by temperature rise | 3 | 6 | 9 | 3 | 12 | 6 | 6 |
| AR2 Temperature - Overhead line structures affected by Summer drought and consequent ground movement | 2 | 4 | 4 | 2 | 9 | 3 | 3 |
| AR3 Temperature / precipitation - Overhead lines affected by interference from vegetation due to prolonged growing season | 10 | 10 | 10 | 12 | 20 | 8 | 8 |
| AR4 Temperature - Underground cable systems affected by increase in ground temperature | 3 | 6 | 9 | 3 | 12 | 6 | 6 |
| AR5 Temperature - Underground cable systems affected by Summer drought and consequential ground movement | 2 | 4 | 4 | 2 | 12 | 4 | 4 |
| AR6 Temperature - Substation and network earthing systems adversely affected by summer heat and drought conditions | 3 | 6 | 6 | 2 | 12 | 4 | 6 |
| AR7 Temperature - Transformers affected by temperature rise | 3 | 6 | 6 | 2 | 12 | 4 | 6 |
| AR8 Temperature - Transformers affected by urban heat islands and coincident air conditioning demand | 3 | 6 | 9 | 2 | 12 | 4 | 6 |
| AR9 Temperature - Switchgear affected by temperature rise | 3 | 6 | 6 | 2 | 12 | 4 | 4 |
| AR10 Precipitation - Substations affected by river (fluvial) flooding due to increased winter rainfall | 16 | 16 | 16 | 12 | 20 | 8 | 8 |
| AR11 Precipitation - Substations affected by pluvial (flash) flooding due to increased rainstorms in Summer and Winter | 12 | 12 | 12 | 12 | 25 | 10 | 8 |
| AR12 Precipitation - Substations affected by sea flooding due to increased rainstorms and/or tidal surges | 15 | 15 | 15 | 12 | 16 | 9 | 12 |
| AR13 Precipitation - Substations affected by water flood wave from dam burst | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| AR14 Lightning - Overhead lines and transformers affected by increasing lightning activity | 3 | 6 | 6 | 3 | 12 | 4 | 4 |
| AR15 Wildfire - Overhead lines and underground cables affected by extreme heat and fire smoke damage | NA | NA | NA | 2 | 12 | 4 | 4 |

**Figure 2: Extract of UKPN Priority Risk Scores for tested scenarios. Including Baseline 2021 and Baseline 2050 (Do Nothing) for related DNO Power supply climate risks**

## *Other Climate Risks identified by the DNOs*

In addition to the Heat Stress/Extreme Heat risks, flooding caused by increased rainfall due to climate change covers 4 other medium/high risks for DNOs (see the UKPN Priority Risk Scores set out above). Again, this supports our findings and the need for us to deliver flood resilience improvements at our critical sites.

## 5.2 Our revised wastewater investment plan

We are prioritising delivery of our power resilience schemes in the River Stour catchment and Eastbourne and our flooding schemes. These schemes have the highest consequence in terms of the environment, bathing waters and local communities. We still believe that the de-prioritised schemes will be required but we recognise the need to focus on the key areas in AMP8.

As set out in our responses in the 'Need' and 'Best Option for Customer' sections below, the benefits of investing in our power resilience solutions in the River Stour catchment are multi-faceted in reducing the risks and likelihood of suffering from pollution events in some of our most environmentally sensitive area. Our October submission provided a benefit calculation methodology based on our service measure framework and the number of historical pollution incidents at our selected sites. The limitation of this methodology is it only accounts for historical performance and we were unable to extrapolate it into a future risk position.

When considered in the round, investing to improve the resilience of the power supplies in our wastewater systems at the selected sites is the top priority for AMP8. This is based on the associated risks of pollution incidents and our understanding of what investment will provide the greater level of resilience across our wastewater operations to lead to better environmental outcomes and be of greatest value for our customers.

## 5.3 Site breakdown of our planned wastewater power resilience investment

| Resilience Scheme Type | Site Name | Total Investment Costs (£m) | Total Estimated Benefits/AMP (£m) |
|---|---|---|---|
| Power – River Stour Catchment and Eastbourne Enhancement Schemes | Elizabeth Street WPS | 0.77 | 0.40 |
| | Margate WPS | 2.52 | 0.59 |
| | Weatherlees Hill A & B WTW | 1.95 | 0.20 |
| | Broadstairs WPS | 1.01 | 0.61 |
| | May Street Herne Bay WTW | 0.88 | 0.05 |
| | Eastbourne WTW | 7.80 | 0.30 |
| | Swalecliffe WTW | 1.75 | 0.50 |
| | **Total** | **16.68** | **2.65** |

**Table 4: Revised wastewater power schemes and costs by site**

### Site breakdown of our planned wastewater flooding resilience investment

| Resilience Scheme Type | Site Name | Total Investment Costs (£m) | Total Estimated Benefits/AMP (£m) |
|---|---|---|---|
| Flooding | Battle | 0.89 | 0.60 |
| | Catsfield | 0.89 | 0.20 |
| | Maresfield | 0.38 | 4.00 |
| | Sedlescombe | 0.89 | 4.00 |
| | Halland | 0.89 | 4.40 |
| | Neaves Lane, Ringmer | 0.89 | 5.50 |

| | | |
|---|---|---|
| **Total** | **4.83** | **18.70** |

**Table 5: Revise wastewater flooding schemes and costs by site**

# 6. Wastewater power resilience - additional information on the need for enhancement investments

Ofwat's deep dive assessment said:

- "The company **does not set out what the baseline risk position is**, by **how much it is increasing**, and **why the proposed scale of investment is the right level** required to manage the increasing risk."
- "The company **does not provide sufficient and convincing evidence that there is an increasing risk from hazards outside of its control**."
- "The company states that the risk **of power outage is increasing due to climate change impact and the changing mix of electricity grid sources due to de-carbonisation**. However, they **do not provide sufficient and convincing evidence of the timeliness of this shift in energy policy driven change**."

As we described in our October submission, the drivers for enhancement investment in our power systems at our wastewater sites are to mitigate the impact power supply interruptions have on our operations and reduce the number of Category 1-3 pollution incidents which harm the environment and impact our customers.

The two main climate risk drivers generating the need for this investment are the:
- increasing frequency and severity of storm events which result in power supply interruptions; and
- Increasing risk of higher temperatures on our power system assets because of climate change.

## *Baseline risk and the need to invest*

One of our highest priorities is to prevent pollution incidents and particularly serious pollution incidents. We are targeting zero serious pollution incidents and enhancing the resilience of our power systems is a critical enabler for this.

Kent has a disproportionate number of pollution incidents in comparison to our other counties, with an increasing prevalence of the most serious incidents. This is illustrated in Figures 3 and 4 below

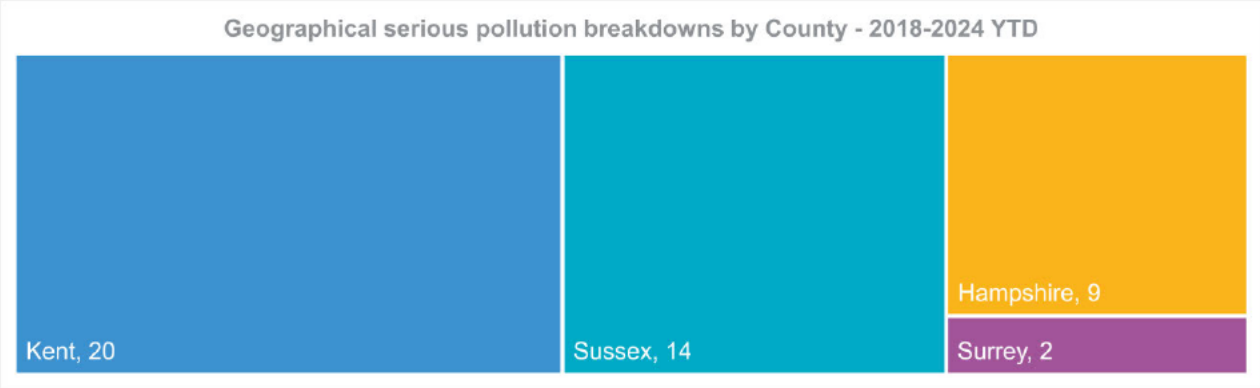


**Figure 3: Breakdown of serious pollution incidents (Cat 1 and 2) by county (2018-2024)**

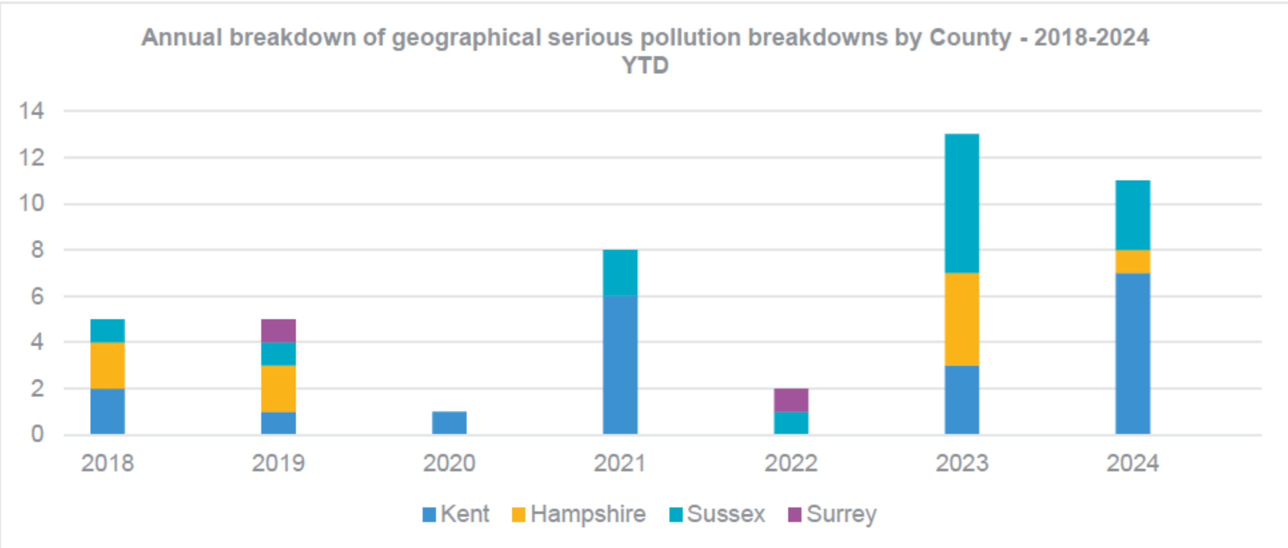


**Figure 4: Breakdown of annual serious pollution incidents (Cat 1 and 2) by county (2018-2024)**

We publish our Pollution Incident Reduction Plan each year which includes an assessment of root cause. In 2021 and 2022 the percentage of pollution incidents due to electrical faults was 28% and 25% respectively. Last year this showed a significant reduction as we addressed the simpler, condition-based issues through our botex plans (12%). However, we now need to address the underlying [redacted] which make these sites vulnerable to the increasing issue of unstable power supplies and brownouts in the Kent area.

## Prioritising investment at sites suffering some of the worst pollution events

The target sites within this resilience case have unacceptably high levels of pollution incidents, across all three categories. These are major terminal pumping stations or treatment works on the Kent coast, directly impacting popular bathing waters. The primary concern for these sites is the resilience of the power supplies and the impact on control systems. In our revised plan, we have prioritised investing in sites in the River Stour catchment and Eastbourne WTW, which have suffered a disproportionate number of serious pollution events, [redacted] of 44 (30%) category 1 and 2 pollution events between 2018-2023.

| Site | Number of Historical Pollution Events | | | Total |
|---|---|---|---|---|
| | Cat 1 | Cat 2 | Cat 3 | |
| Margate WPS | [redacted] | | | |
| Broadstairs WPS | [redacted] | | | |
| Swalecliffe WTW | [redacted] | | | |
| Eastbourne WTW | [redacted] | | | |
| May Street Herne Bay WTW | [redacted] | | | |
| Elizabeth Street Dover WPS | [redacted] | | | |
| Weatherlees Hill B (MGATE & Bstairs) WTW | [redacted] | | | |
| **Sub-Total (Progressed)** | [redacted] | | | |
| Broomfield Bank WTW | [redacted] | | | |
| Folkestone Junction WPS | [redacted] | | | |
| The Stade Folkestone WPS | [redacted] | | | |
| **Sub-Total (Not Progressed** | [redacted] | | | |
| All Other Sites | [redacted] | | | |
| **Total** | **6** | **38** | **4101** | **4145** |

**Table 6: Summary of Cat 1-3 pollution incidents experienced at our selected sites compared to our whole region (2018-2023)**

## Customer support for power resilience solutions

As stated in our October submission, resilience was ranked our customers' third highest priority in the engagement activity we carried out to understand their priorities for our environmental ambition, It only followed sewer infiltration and storm overflows.

Our extensive customer engagement showed us:

- Schemes to resolve power issues were considered low risk as the solutions appeared to be tangible and relatively easy to implement
- Our customers support proactive and preventative investment in power-related equipment, given the potential impact of inaction
- While customers do not welcome bill increases or advocate a bigger bill increase than predicted, they do accept it feels the right time to invest in the infrastructure
- Customers want us to push hard to address pollution and feedback on our proposed plan shows they want us to be even more ambitious to drive down the number of pollution events.

### *Increasing risk from hazards outside our control*

In the previous section we explained the current risk for these key assets. An increase in extreme weather events is already leading to loss of power leading to serious pollution events. This is exacerbated by the decarbonisation of the grid resulting in increased brown outs, power blips and unplanned outages. It means the power resilience of these critical assets needs to be enhanced from previous design standards.

These risks are only going to increase as climate change continues to lead to more extreme events. Our original October submission set out evidence to show extreme weather events (storms) are becoming more common. In this submission we summarise the main arguments.

In addition to the increasing severity of storms there is a growing vulnerability of power supplies to increasing temperatures. This is described in our section describing our learnt experiences from extreme weather events as it is applicable to our water resilience cases too. In summary, temperatures will increase in the coming years with Kent being worst affected. increases in temperature significantly add to power supply risks due to the impact on transformers, switch gear and substations. We provide evidence from our own research and demonstrate this is corroborated by similar UKPN research.

Overall, this demonstrates there is evidence to show real impact already, which will only get worse as the risks from severe storms and increased temperatures increase.

### *Recap of our October submission and subsequent query*

Previous submissions provided evidence that we should expect to see more severe storms in the future, which will impact the reliability of power supplies in the Kent area. Extreme weather events are becoming more common and more difficult to predict. The severity of these events means they often lead to losses due to increasing population, increasing infrastructure and the natural variability of the climate. According to the Met Office, the frequency of some extreme events has changed, with evidence to show increasing sea temperatures are increasing the intensity of storms[4]. During the past 5 years we have been impacted by 33 named storms, which has resulted in disruption to a significant number of customers' water supply and 414 pollution events.

[4] Met Office Extreme Weather Events and Climate

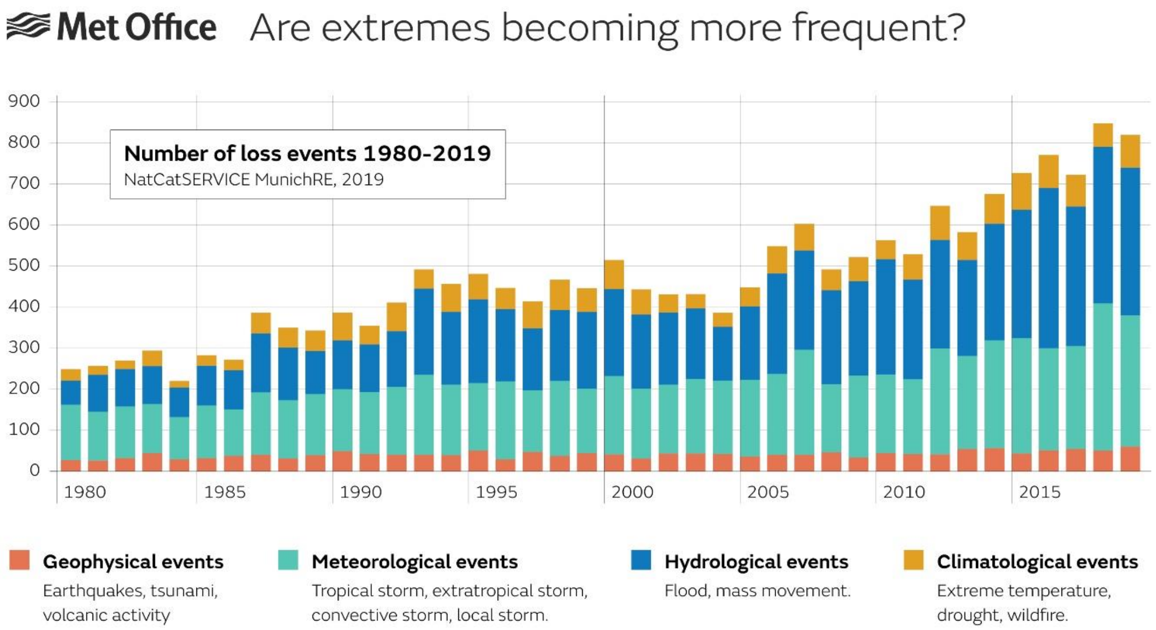


**Figure 5: Increasing number of extreme weather events from 1980 to 2019**

Our experience and data clearly indicate that extreme weather events have impacted the power infrastructure we rely on and led to interruptions to the main power supply. Extreme weather, such as severe storms, can impact our power supplies, e.g. extreme wind can cause falling trees and debris to impact overhead transmission cables and pylons. Aside from the risk of this debris potentially severing the Overhead transmission line, an added risk arises as these lines are normally bare (uninsulated) and if an object gets too close a 'flashover' can occur, where electricity will jump over a distance to reach earth via the object. Additionally, extreme temperatures can impact on the ability of an overhead line cable to carry power, as the transmission lines swell from excessive heat. For assets where we do not operate an auxiliary power supply, this can result in our booster stations and service reservoirs being unable to provide safe drinking water for our customers. Our pumping stations and wastewater treatment works are unable to transport waste through our network, resulting in pollution events and discharges to watercourses and the sea.

## *Our experience of extreme weather events – case study*

We have actively learnt lessons from previous extreme weather events, such as Storm Arwen and the Storms of February 2022 (including Storm Eunice). These caused power supply interruptions which in turn affected our operations.

The UK Government 'Storm Arwen review: final report' identified the water sector "experienced impacts due to electricity disruption during Storm Arwen where sites lacked back-up electricity supplies."5

[5] Storm Arwen review: final report (publishing.service.gov.uk)

Throughout February 2022, the UK suffered 11 days of the largest storm events the UK has seen in 35 years, with three major storms in quick succession. These caused widespread damage and disruption across the country. The storms included: Storm Dudley – 16th February, Storm Eunice – 18th February and Storm Franklin – 21st February.

Across our region our two DNOs (UKPN and SSEN) suffered significant disruption caused by the extreme weather:

- UKPN suffered a month's worth of faults in a single day across 1,800 locations, resulting in damage to 46,000km of overhead power lines. [6]
- SSEN was impacted by more than 1,000 points of damage across its network, the equivalent of 6 months typical overhead line faults. [7]

Due to the succession of storm events, more than 70,000 customers and businesses across Southern England remained without power two days after Storm Eunice.

For our operations, during the storm events of February 2022, we suffered significant asset downtime across our wastewater network because of the widespread network power disruption issues. Across the 11 days of storm events, more than 550 of our sites had periods of time without power and more than 43,000 asset alarms triggered.

| Asset Type | Total No. Sites Impacted by loss of Mains Power | No. Sites with continued Asset Downtime | Asset Downtime (Hours) |
|---|---|---|---|
| **Wastewater Treatment Works** | 131 | 67 | 23,817 |
| **Wastewater Pumping Station** | 365 | 79 | 5,485 |

**Table 7: Summary of impact from Storm Eunice**

During these events we operated 387 fixed on-site generators across our network to provide power supply to our sites. In addition, we deployed 47 mobile generators and utilised 42 generators from our supply chain.

During the past 5 years, the UK has been impacted by 33 'named' storms, resulting in 414 pollution incidents. The criteria used for naming storms is based on the Met Office's 'National Severe Weather Warnings service'. This is based on the impact the weather may have and the likelihood of those impacts occurring. A storm will be named when it has the potential to cause an amber or red warning.

As previously highlighted through the UK Met Office climate change projections update (UKCP18), it is widely accepted that the frequency and magnitude of extreme weather events will continue to increase. These same projections have been used in Ofwat's common reference scenarios for climate change and are the basis for the Ofwat selected Representative Concentration Pathways (RCPs) 2.6 and 8.5[8]. Under these scenarios, extreme weather events are expected to increase in frequency, and we consider our proposals

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[6] Engineers work to restore power after Storm Eunice hit the South East | UK Power Networks
[7] Looking back at Storm Eunice - SSEN
[8] PR24 and beyond: Long-term delivery strategies and common reference scenarios – Section 3.2.1 Climate Change

here as a demonstration of our intention to invest in the right long-term solutions, collaborate and work with nature to deliver better outcomes, enhance our resilience and protect and improve the environment.

The need to undertake enhancements of our critical sites is further supported by National Security Strategy (NSS) to improve the resilience of critical infrastructure. The cabinet office's "Keeping the Country Running: Natural Hazards & Infrastructure"[9] documents the UK government's desire to encourage an "ability in organisations and their infrastructure networks and systems to absorb shocks and recover; and enabling an effective local and national response to emergencies".

Learning lessons from these storm events has shown us the strategic importance of building redundancy, resistance and reliability into the power systems at our critical sites. This will allow us to continue to provide essential services to customers and protect the environment during significant storm events when our DNOs suffer power outages.

In our query response from February 2024, we provided additional information on how variability in frequency and severity of storm events are providing an increased risk to our power infrastructure outside our control.

Figure 6 and Table 8 show additional statistics on the number of named storms in the UK, since the naming convention and criteria were introduced. The data shows significant annual variability of named storms in the UK. Combined with our learnt experiences, specifically from the storm events in 2022, we have seen an upturn in the severity of these storms that has resulted in significant impacts on our operations. Since our submission in October 2023, the UK has had 9 named storms, more than double the number from 2022/23.

Additionally, when assessed in conjunction with the UK Government focus on ensuring our critical infrastructure is resilient, this strengthens the need for us to be able to cope with 8-11 storms every 8 years, against a current baseline of being able to manage between 4 and 7 on an annual basis.

[9] Cabinet Office "Keeping the Country Running: Natural Hazards and Infrastructure"

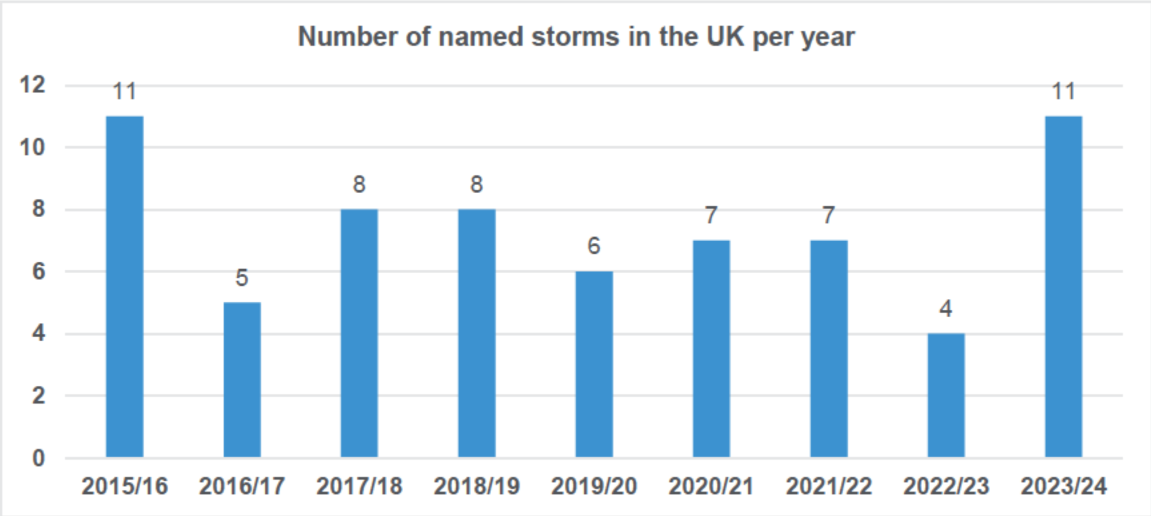


**Figure 6: Annual number of UK Named Storms 2015/16 - 2023/24**

| Year | No. Named Storms | Names of Storms | Source |
|---|---|---|---|
| 2023/24 | 11* | Agnes, Baber, Ciaran, Debi, Elin, Fergus, Gerrit, Henk, Isha, Jocelyn, Kathleen | UK Storm Centre - Met Office |
| 2022/23 | 4 | Otto, Noa, Antoni, Betty | UK Storm Season 2022/23 - Met Office |
| 2021/22 | 7 | Arwen, Barra, Malik, Corrie, Dudley, Eunice, Franklin | UK storm season 2021/22 - Met Office |
| 2020/21 | 7 | Alex, Barbara, Aiden, Bella, Christoph, Darcy, Evert | UK Storm Season 2020/21 - Met Office |
| 2019/20 | 6 | Atiyah, Brendan, Ciara, Dennis, Jorge, Ellen, Francis | UK storm season 2019/20 - Met Office |
| 2018/19 | 8 | Ali, Bronagh, Callum, Deirdre, Erik, Freya, Gareth, Hannah | UK storm season 2018/19 - Met Office |
| 2017/18 | 8 | Aileen, Ex-Hurricane Ophelia, Brian, Caroline, Dylan, Eleanor, Fionn, David, Georgina, Hector | UK storm season 2017/18 - Met Office |
| 2016/17 | 5 | Angus, Barbara, Conor, Doris, Ewan | UK storm season 2016/17 - Met Office |
| 2015/16 | 11 | Abigail, Barney, Clodagh, Desmond, Eva, Frank, Gertrude, Henry, Imogen, Jake, Katie | UK storm season 2015/16 - Met Office |

**Table 8: Annual Number of UK named storms and associated details**

The Met Office states trends in windstorm numbers are difficult to detect, due to how these naturally vary year-to-year and decade-to-decade[10]. But research in the UKCP18 Storms Factsheet[11] suggests that across the UK, winter storms are likely to increase in both frequency and severity towards the end of the century. Figure 7 shows the relevant snapshot from the Factsheet report, and associated text.

While the direction of these trends is robust across different climate models and different analysis approaches, there are differences in the size of the change (Feser et al., 2015) due to variation in how different climate models represent the factors that drive windstorm development (see next section). Also note that projected changes for the British Isles contrast with those over the wider North Atlantic, where Figure 3 shows a decrease in storm numbers but storm intensity shows an increase.

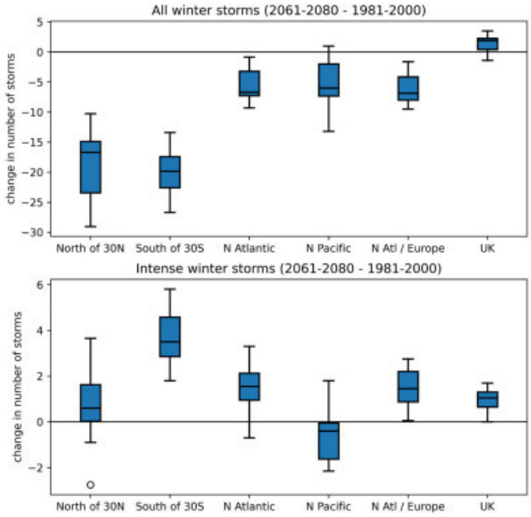


**Figure 3** Change in winter (Dec-Jan-Feb) storm counts in UKCP Global PPE-15, comparing recent (1981-2000) and future (2061-2080) climates under RCP8.5. The storm events are tracked in the vorticity about 1km above the ground (on the 850hPa pressure surface). Intense storms are defined as those where the 850hPa vorticity goes over 11x10-6 s-1. The regions are defined as follows: North Pacific: 120 to 240 °E and 30 to 70 °N; North Atlantic: 80° W to 10° W, 30 to 70 °N; North Atlantic / Western Europe: 30° W to 30° E, 35 to 80 °N; and UK: 10 °W to 2 °E and 48 to 62 °N.

[2] CMIP6 is the Coupled Modelling Intercomparison Project 6's dataset is the underpinning data for the Intergovernmental Panel on Climate Change (IPCC)'s Sixth Assessment Report (AR6), published in 2022/2023 and available from: https://www.ipcc.ch/assessment-report/ar6/. CMIP5 underpinned the IPCC's Fifth Assessment Report (AR5), published 2013/2014.

www.metoffice.gov.uk Pg 5 of 11 Source: Met Office © Crown Copyright 2023

**Figure 7: Snapshot of UKCP18 Storm Factsheet indicating predicted future storm frequency and severity**

[10] [UK Storm Centre - Met Office]
[11] [ukcp18-factsheet-storms.pdf (metoffice.gov.uk)]

### *Our revised wastewater power resilience investment*

Based on further analysis, work we've completed since October and the feedback and outcomes of the draft determination, we have made significant changes to our AMP8 plans to invest in power resilience.

In AMP8 we are prioritising investment to enhance our power system assets at 7 of the 10 proposed sites in the River Stour catchment and Eastbourne WTW, where we are upgrading our assets to manage additional DNO power supplies at each site. More information on the works at our proposed sites is provided below.

We have made the difficult decision to not progress with our request to use enhancement funding to install fixed standby generator solutions at our 11 proposed wastewater sites in AMP8. We will continue to monitor the need for this investment through AMP8 and consider any future enhancement power resilience investment needs for AMP9 and beyond.

## 6.1 Wastewater power resilience - additional information on the best option for customers

Ofwat's deep dive assessment said:

- *The choice of options presented relates to **different scales of programme** as **opposed to different options**.*
- *The benefit calculations are shown in the context of a Service Measure Framework. However, the company **presents the benefits for the chosen solution only**, and the **main components of the scheme do not appear to be cost beneficial.***
- *The company states that **standby generator schemes carbon and operational costs have currently been assessed to be negligible** because they will be used by exception in emergencies. This approach does not consider embedded carbon and could lead to best value solutions being overlooked. There is not sufficient and convincing evidence that the best option has been selected.*

### *Additional information on the need for enhancement work required at our sites*

In our October business plan submission, we provided an overview of the enhancement work to be delivered at each of the sites in our River Stour Catchment and Eastbourne schemes. But we did not provide additional context and information on the need for this investment and the work we have undertaken to isolate the enhancement activity from other base expenditure activities work to be completed at these sites.

Across our seven (7) sites in the River Stour catchment and Eastbourne WTW schemes we need to upgrade the capacity and rating of our power system assets. **We have designed solutions which prioritise removing [redacted] from our power assets and systems while increasing the systems' resistance to external factors outside of management control and enhancing the level of redundancy of the operations in our most critical sites.**

The type of work we will deliver includes enhancing our power assets to be able to operate under new environments with:

- additional DNO power supplies
- uprated standby generators to provide resilient power supply during storm conditions.

This will allow us to operate more safely and reduce the likelihood of suffering more historical catastrophic transformer failures, which are anticipated to become more frequent as the impacts of climate change continues to materialise.

Without upgrading and uprating our own power system assets, these sites will be unable to operate with their new configurations and our operations and customers will continue to be at risk in the event of brown and blackout power interruptions.

Additionally the sites we are progressing with have operational challenges that make a response based approach ineffective. Many of these sites have short time to spill metrics due to the sites operating with relatively low storage capacity. Additionally as these sites are all located near one another, it is difficult to provide enough qualified response teams during storm events to react and bring the site back online within the required timescales.

### *Additional information on site-specific work and site context for our power resilience*

Specific information on the works at each site is presented in Tables 9-16 below, along with an overview of activities we have re-assessed and understand to be capital maintenance expenditure and therefore will fund through base allowances. This typically included costs associated with activities to inspect assets on site. These items have been removed from our revised submitted costs.

| | Direct Costs | | | | | Total Costs |
|---|---|---|---|---|---|---|
| | Base | | Enhancement | | Estimated | Estimated |
| Site | £m | % | £m | % | £m | £m |
| Elizabeth Street WPS | £0.0 | 0% | £0.39 | 100% | £0.39 | £0.77 |
| Margate WPS | £0.0 | 0% | £1.26 | 100% | £1.26 | £2.52 |
| Weatherlees WTW | £0.0 | 0% | £0.98 | 100% | £0.98 | £1.95 |
| Broadstairs WPS | £0.0 | 0% | £0.51 | 100% | £0.51 | £1.01 |
| May Street WTW | £0.0 | 0% | £0.44 | 100% | £0.44 | £0.88 |
| Eastbourne WTW | £0.045 | 1% | £3.91 | 99% | £3.95 | £7.89 |
| Swalecliffe WTW | £0.005 | 1% | £0.87 | 99% | £0.88 | £1.75 |
| **Totals** | £0.050 | **1%** | £8.36 | **99%** | £8.41 | £16.78 |

**Table 9: Breakdown of activity classification at each site being progressed**

Specific site summaries are provided below, giving more context to the site requirements and the work we plan on delivering in AMP8.

| Elizabeth Street WPS | Revised Budget: £0.77m |
|---|---|

**Site Specific Context**

- [redacted]

**Information on the work to take place at this site**

- [redacted]

Table 10: Specific context on work to be delivered at Elizabeth Street WPS

| Margate WPS | Revised Budget: £2.52m |
|---|---|

**Site Specific Context**

- [redacted]

**Information on the work to take place at this site**

- [redacted]

[redacted] Specific context on work to be delivered at Margate WPS

| Weatherlees Hill A & B WTW | Revised Budget: £1.95m |
|---|---|
| Site Specific Context<br>- [redacted]<br>Information on the work to take place at this site<br>- [redacted] | |

Table 12: Specific context on work to be delivered at Weatherlees Hill A&B WTW

| Broadstairs WPS | Revised Budget: £1.01m |
|---|---|
| Site Specific Context<br>- [redacted]<br>Information on the work to take place at this site<br>- [redacted] | |

Table 13: Specific context on work to be delivered at Broadstairs WTW

| May Street Herne Bay WTW | Revised Budget: £0.88m |
|---|---|
| Site Specific Context<br>- [redacted]<br>Information on the work to take place at this site<br>- [redacted] | |

Table 14: Specific context on work to be delivered at May Street Herne Bay WTW

| Eastbourne WTW | Revised Budget: £7.89m |
|---|---|

| |
|---|
| **Site Specific Context**<br>- [redacted]<br>- [redacted]<br>- [redacted]<br>- [redacted]<br>- [redacted] |
| **Information on the work to take place at this site**<br>- [redacted]<br>  - [redacted]<br>    - [redacted]<br>  - [redacted]<br>  - [redacted]<br>  - [redacted]<br>  - [redacted] |

Table 15: Specific context on work to be delivered at Eastbourne WTW

| Swalecliffe WTW | Revised Budget: £1.79m |
|---|---|
| **Site Specific Context**<br>- [redacted]<br>- [redacted]<br>- [redacted] | |
| **Information on the work to take place at this site**<br>- [redacted]<br>  - [redacted]<br>  - [redacted] | |

Table 16: Specific context on work to be delivered at Swalecliffe WTW

## *Sites not progressing with enhancement funding*

Based on additional analysis we have completed since October and following our draft determination outcome, we no longer plan to progress the following 3 sites we originally proposed. This is based on a combination of:

- Reviewing the works to be delivered at sites and identifying a significant proportion as capital maintenance (Broomfield Bank WTW)
- Considering other power resilience investment in the catchment and our understanding that these interventions will provide a suitable level of control against pollution incidents as a result of power failures in this geographical region (Folkestone Junction WPS and The Stade WPS)

| Site | Direct Costs | | | | | Total Costs |
|---|---|---|---|---|---|---|
| | Base | | Enhancement | | Estimated | Estimated |
| | £m | % | £m | % | £m | £m |
| Folkestone Junction WPS | £0.018 | 3% | £0.549 | 97% | £0.57 | £1.13 |
| The Stade WPS | £0.000 | 0% | £0.297 | 100% | £0.30 | £0.59 |
| Broomfield Bank WTW | £0.180 | 100% | £0.000 | 0% | £0.18 | £0.36 |
| Totals | £0.198 | 19% | £0.846 | 81% | £1.04 | £2.08 |

**Table 17: Breakdown of activity types for our 3 sites we don't plan on progressing**

## *Our choice of different options*

In terms of options, we have already significantly enhanced our detection and response approach with additional alarms, improved our out of hours response and given these sites the highest priority for alarm management. Site surveys and condition assessments have supported the necessary refurbishment via capital maintenance investment. The only remaining option now is to remove these [redacted], enhancing the assets to provide additional resilience.

As part of the reprioritisation work for this submission we have deselected standby generation because alternative mitigation measures such as mobile generation or tankering offer viable options for each site. It should be noted that during widespread storm and power outage events such as Storm Eunice, [redacted]. These alternative options are not viable for our remaining priority sites due to their size.

Coupled with a prioritisation based on operational impact and the other risk factors described in this document, we have considered the best option for customers holistically.

## *Alignment of investment to other strategic objectives*

Improvements in power resilience at our wastewater sites will help us deliver 'Healthy rivers and seas' through building resilience at our wastewater treatment works and ensuring our pumping stations continue to operate effectively as our climate changes.

### *Cost benefit analysis response*

We recognise the cost benefit methodologies presented in our October submission do not directly show all the benefits associated with investing in our wastewater power resilience schemes.

While we used our SMF framework to quantify the potential benefits of avoiding historical pollution events at the same sites, there are other considerations of the benefits of our proposed scheme which are not considered in the quantification methodology. These include alignment to our:

- Strategic objectives and targets of no serious pollution events
- Customer priorities through our PR24 customer engagement activity.

| Resilience Scheme Type | Site Name | Total Investment Costs (£m) | Total Estimated Benefits/AMP (£m) |
|---|---|---|---|
| Power – River Stour Catchment and Eastbourne Enhancement Schemes | Elizabeth Street WPS | 0.77 | 0.40 |
| | Margate WPS | 2.52 | 0.59 |
| | Weatherlees Hill A & B WTW | 1.95 | 0.20 |
| | Broadstairs WPS | 1.01 | 0.61 |
| | May Street Herne Bay WTW | 0.88 | 0.05 |
| | Eastbourne WTW | 7.80 | 0.30 |
| | Swalecliffe WTW | 1.75 | 0.50 |
| | **Total** | **16.68** | **2.65** |

**Table 18: Revised wastewater power schemes and costs by site**

## 6.2 Wastewater power resilience – additional information on cost efficiency

In Ofwat's deep dive assessment, it was stated:

- The company **does not provide sufficient and convincing evidence that the costs are efficient**.
- The company **does not provide evidence of cost benchmarking or evidence that costs have been externally assured**.

As we have indicated throughout this document, the scope of our planned works has changed significantly for our wastewater climate resilience investment, and we are no longer prioritising installation of standby generators as a solution for our wastewater investment.

Based on this, the information below provides evidence of the cost efficiency and external benchmarking work we have completed since October

Since our October submission, our Engineering and Cost Intelligence teams have reviewed and revised the scope of work for each site and provided updated cost estimates. These updated cost estimates have been externally benchmarked by Mott MacDonald.

### *External cost benchmarking*

Since October, and through additional support from our engineering team, Mott MacDonald has carried out cost benchmarking for the 10 sites in the River Stour catchment and Eastbourne WTW we originally proposed.

We have employed an iterative approach to benchmarking these costs, after further refining our scope of works. Originally, we had 58% of costs benchmarked and we have since increased this to 97.6%.

## Benchmarking findings and key facts (see further Table 19 below)

- Across the 10 sites there was a total of 97.6% scope coverage.
    - 7 sites had 100% coverage, 2 sites over 90% coverage and 1 site had 79.6% coverage.
- The benchmarking indicates the scope costs for the schemes is 10.4% more expensive than the benchmark, which is within acceptable good practice tolerances.
- We provided Mott MacDonald with our scope of works for each site and they applied, and where possible aligned, top-down cost models from their database to the varying asset and equipment level models and their outputs.
- Data used to complete the benchmarking was gathered from the data of 2 comparable water companies.
- The costs were normalised with respect to inflation using the CPIH inflation index.
- The price base is set to 1Q2023.
- The costs have been normalised with respect to the construction location, helping mitigate the effects of regional purchasing power, to improve the benchmark accuracy.

| Site | Budget Benchmarked | Coverage | Benchmarked Value | Variance | Quotes/Framework |
|---|---|---|---|---|---|
| Margate WPS | £ 3,190,351.25 | 90.9% | £ 3,852,330.00 | 17.2% | £ 69,055.00 |
| Swalecliffe WTW | £ 2,441,210.00 | 100.0% | £ 2,251,612.60 | -8.4% | £ 98,980.04 |
| Broadstairs WTW | £ 1,283,787.50 | 91.1% | £ 1,220,151.50 | -5.2% | £ 123,829.00 |
| Eastbourne WTW | £13,211,580.00 | 100.0% | £10,099,267.50 | -30.8% | £ - |
| May Street WTW | £ 976,372.50 | 79.6% | £ 1,154,065.00 | 15.4% | £ 288,486.00 |
| Weatherlees Hill A&B WTW | £ 2,737,500.00 | 100.0% | £ 2,685,192.50 | -1.9% | £ 288,486.00 |
| Broomfield Bank WTW | £ 500,000.00 | 100.0% | £ 1,062,500.00 | 52.9% | £ - |
| Elizabeth Street WPS | £ 1,735,000.00 | 100.0% | £ 1,453,987.50 | -19.3% | £ - |
| Folkestone Junction WPS | £ 1,575,000.00 | 100.0% | £ 815,607.50 | -93.1% | £ 127,480.00 |
| The Stade WPS | £ 825,000.00 | 100.0% | £ 1,201,727.50 | 31.3% | £ 65,978.00 |
| Total | £28,475,801.25 | 97.6% | £25,796,441.60 | -10.4% | £1,062,294.04 |

**Table 19: Overview of the cost benchmarking findings from Mott MacDonald Cost Benchmarking Report**

### *Changes in cost from October submission*

Our proposed costs for our power-related climate resilience investments have changed since October for two main reasons:

1) Reduction in scope:
   a) prioritising 7 of our 10 original sites based on site specific risks - **-£2.7m**; and
   b) deferring our wastewater standby generator solutions - **-£5.9m**
2) Applying a 10% cost efficiency challenge on our schemes based on the output of the external cost benchmarking completed by Mott MacDonald - **-£1.6m.**

The result is **we are now requesting £16.7m to invest to improve our power resilience in AMP 8**. This is a **total £10.2m reduction** from the **£26.9m we originally requested in October**.

## 6.3 Wastewater flood resilience investment – overview of changes

We have not proposed any changes in scope in our flooding resilience investment in AMP8. However, we have understood concerns over cost efficiency raised in the deep dive assessment (discussed further below) and challenged ourselves to apply a 10% cost reduction.

This has resulted in a plan to deliver flood defences at our original 6 sites **for a total investment of £4.83m.**

| Resilience Scheme Type | Site Name | Total Investment Costs (£m) | Total Estimated Benefits/AMP (£m) |
|---|---|---|---|
| Flooding | Battle | 0.89 | 0.60 |
| | Catsfield | 0.89 | 0.20 |
| | Maresfield | 0.38 | 4.00 |
| | Sedlescombe | 0.89 | 4.00 |
| | Halland | 0.89 | 4.40 |
| | Neaves Lane, Ringmer | 0.89 | 5.50 |
| | **Total** | **4.83** | **18.70** |

**Table 20: Revised flooding resilience investment**

## 6.4 Wastewater flood resilience – response to feedback on the need

Ofwat's deep dive assessment stated:

- The investment meets the criteria for enhancement investment and additional customer funding. The company demonstrates the need for enhancement investment – clearly set out with sufficient and convincing evidence.
- The company provides evidence of this investment improving resilience, and it is shown that there is a clear separation from base expenditure and previous enhancement funding. The company uses Environment Agency flood map data and provides sufficient and convincing evidence of past flooding in their enhancement case document. The company responded to a query indicating the driver for the investment is the change in flood risk zones scoring, showing an increasing risk.

### *Our response to the need for enhancement investment*

As we passed this assessment, we are not presenting additional evidence to support the need for this enhancement investment.

## 6.5 Wastewater flood resilience – response to feedback on best option for customers

Ofwat's deep dive assessment stated:

- Minor concerns whether the investment is the best option for customers.
- The company considers a range of alternative options **but does not provide sufficient and convincing evidence to demonstrate that the chosen options are the most cost beneficial** relative to each other.

We understand the minor concerns raised about only providing cost benefit analysis of our proposed option and not providing a comparison to the other options considered.

As we stated in our October submission, the proposed solution for Battle WTW, Catsfield WTW, Sedlescombe WTW, Halland WTW and Neaves Lane Ringmer WTW is a combination of three individual options around installing temporary flood barriers, building site perimeter defences and contributing to other catchment-wide schemes to minimise the likelihood of suffering flooding at these sites and building in long-term resistance measures to protect them in the future.

This combination of solutions made it difficult to compare the costs and benefit against the individual components of the solution, with the most effective comparison being the cost of doing nothing and suffering the operational impact at our selected sites based on historical incidents.

| WTW Site | AMP8 Solution Budget (£) | Annual Forecast Service Impact Benefit (£) | Anticipated Flood Event Frequency | Forecast Cost Beneficial Payback (years) | Annual Forecast OPEX Cost | Forecast Embedded Carbon (tCO2e) |
|---|---|---|---|---|---|---|
| Battle | £0.99m | £0.11m | 1 in 5 years | 8.9 | £0.00 | 26.48 |
| Catsfied | £0.99m | £0.05m | 1 in 5 years | 20.8 | £0.00 | 26.48 |
| Maresfeild | £0.42m | £0.80m | Annual | 0.5 | £0.00 | 7.7 |
| Sedlescombe | £0.99m | £0.80m | Annual | 1.2 | £0.00 | 26.48 |
| Halland | £0.99m | £0.87m | Annual | 1.1 | £0.00 | 26.48 |
| Neaves Lane, Ringmer | £0.99m | £1.10m | Annual | 0.9 | £0.00 | 26.48 |
| Total | £5.36m | £3.73m | | 1.4 | 0.00 | 140.10 |

**Table 21: Summary table showing the 6 sites approved for no regrets investment during AMP8**

## 6.6 Wastewater flood resilience – response to feedback on cost efficiency

Ofwat's deep dive assessment stated:

- The company does not provide sufficient and convincing evidence that the proposed costs are efficient.
- The company provides a description of the costing methodology and third-party benchmarking, but it is **not obvious how the specific costs have been built up or benchmarked.**
- Industry and cost benchmarking is utilised in the generic cost models, but the **company states they have low degrees of confidence in design maturity and medium degrees of confidence in scheme complexity** for the activity to be delivered at each site, indicating potential inefficiency at this stage.
- The company has provided **limited evidence on benchmarking and external assurance.**

### *Our response to the cost efficiency challenge*

We recognise the minor concerns you stated on our plan as part of the draft determination deep dive and **we have accordingly applied a 10% cost efficiency on our schemes.**

Our costs for the Flooding solutions were developed by Mott MacDonald who developed our *'Southern Water Climate Change Adaptation Costing Tool'* to estimate the costs associated with our AMP 8 solutions.

This tool was developed and operated by Mott MacDonald and used a variety of data sources, listed below:

- Southern Water top-down cost models (cost curves),
- Industry top-down cost models (cost curves);
- bottom-up, benchmarked cost rates from the Mott MacDonald database; and
- Early-stage contractor quotes

**This tool and the same approach was applied to both Flooding and Heat Stress solution cost estimates.**

**As our tool used independent cost benchmarking data from Motts MacDonald as part of the methodology to develop the cost estimates for the proposed solutions. We believe this should alleviate some of your concern that the solutions costs had not been benchmarked or assured.**

# 7. Our revised water investment plan

## 7.1 Recap – overview of changes to our water operational resilience investment plans

Across our power and heat stress operational resilience plans for water, **our plan has increased by £1.1m** through a combination of:

- increased understanding of the costs associated with the works required to install standby generators at each site; and
- an associated re-prioritisation of site investment (water supply works and booster stations) to minimise total cost increases for the programme.

We still intend to deliver our 2 heat stress water solutions through the climate resilience uplift mechanism, to help prepare some of our critical sites to operate reliably in the higher ambient temperatures we are seeing through the effects of climate change.

These solutions have been prioritised using several criteria, which are explained in this document. They are designed to make our operations more resilient to the impacts of asset heat stress on our and DNO-owned assets by providing more redundancy at our most critical water sites which do not currently have fixed standby generators.

The planned investment has also been designed to maximise the use of the indicated water allocation for the climate resilience uplift mechanism. More information and evidence to support the changes in our plan is provided in the following section.

| Ref. | Scheme Type | Total AMP 8 Oct 2023 | Ofwat challenge | Allowed at DD | Our response Aug 2024 | Change | Total |
|---|---|---|---|---|---|---|---|
| Progressed | Heat Stress | £1.5m | 100% | £0m | Request all 2 sites to progress through climate resilience uplift mechanism | - | £1.5m |
| | Power – Standby Generators | £4.8m | 100% | £0m | Request 5 of 9 sites to progress through climate resilience uplift mechanism | +£1.1m | £5.9m |
| Sub-Total | | £6.3m | - | £0m | - | +£1.1m s | £7.4m |

**Table 22: Overview of the changes in our water investment plans compared to our October submission and draft determination outcome**

| Resilience Scheme Type | Site Name | Total Investment Costs (£m) | Total Estimated Benefits/AMP (£m) |
|---|---|---|---|
| Heat Stress | [redacted] | 0.75 | 0.61 |
| | | 0.75 | - |
| | **Sub-Total** | **1.49** | 0.61 |
| Power – Standby Generators | [redacted] | 1.17 | 1.79 |
| | | 0.35 | 0.76 |
| | | 2.10 | 0.62 |
| | | 1.17 | 0.47 |
| | | 1.17 | 0.31 |

| | | | |
|---|---|---|---|
| | Sub-Total | 5.95 | 3.94 |
| | Total | 7.44 | 4.55 |

**Table 23: Site specific power and heat stress water resilience investments for AMP8**

## 7.2 Water power resilience – additional information on the need for enhancement investments

As we described in our October submission, the drivers for enhancement investment in our power system assets at our water sites is to build in additional redundancy to help reduce the risks of interruptions to the mains-driven power supply on site and supply interruptions for our customers.

As with the drivers to invest in power resilience in our wastewater system, the two main climate risk drivers for this investment are the:

- Increasing frequency and severity of storm events which result in power supply interruptions; and
- Increasing risk of higher temperatures on our power system assets because of climate change.

The section below sets out additional information on the changes we have made to our plan while also addressing the feedback from the deep dive review at draft determination. Much of the additional evidence provided for our wastewater schemes is repeated here for the ease of reviewing this document.

## 7.3 Additional information on how our water power resilience plan has changed

Based on further analysis, work we have completed since October and consideration of the feedback and outcomes in the draft determination, we have had to re-prioritise the scope of our AMP8 plans to invest in power resilience.

We are prioritising investment to install fixed standby generators at 5 of the 9 proposed sites. This is to build additional redundancy into our operations to mitigate the risk of water supply interruptions as a result of DNO power supply interruptions.

In October we had made an assumption that all generators would need to be 250kVA. Since then our engineering team has developed site specific requirements for the generator size and associated works required to complete this enhancement work. These site specific generator size requirements for our selected sites are shown in Table 24 and 25. This increase in design maturity from our October submission has produced updated and more accurate costs from our Cost Intelligence Team. More information on this change is provided in the Cost Efficiency section below.

| Site | Generator Size | Updated Direct Costs | Updated Total Costs |
|---|---|---|---|
| | | £m | £m |
| [redacted] | 750kVA | £0.58 | 1.17 |
| | 100kVA | £1.77 | 0.35 |

| | | | |
|---|---|---|---|
| [redacted] | 1250kVA | £1.05 | 2.10 |
| | 750kVA | £0.58 | 1.17 |
| | 750kVA | £0.58 | 1.17 |
| Totals | | £2.98 | £5.95 |

**Table 24: Updated generator sizes and associated costs for sites we are progressing in AMP8**

Across these 5 sites, our solution is designed to help remove [redacted] from our power assets and system by installing standby generators that are rated to be able to operate the entire site during storm conditions.

## *Sites we are not progressing with through enhancement funding in AMP8*

Based on additional analysis we have completed since October and following our draft determination outcome, we no longer plan to progress the following 4 sites we originally proposed. This is based on:

- prioritising sites where we have historically seen more power alarm faults and where there is the most significant customer impact in the event of water supply interruptions
- removing sites where there are suitable interconnections within the water resource zones.

| Site | Generator Size | Direct Costs | Total Costs |
|---|---|---|---|
| | | £m | £m |
| [redacted] | 1250kVA | 0.65 | 1.29 |
| | 750kVA | 0.58 | 1.17 |
| | 1870kVA | 1.15 | 2.29 |
| | 250kVA | 0.23 | 0.46 |
| Totals | | £2.61 | £5.21 |

**Table 25: Updated generator sizes and associated costs for sites we are not progressing in AMP8**

## *Summary of water sites investment*

Investment in these sites is part of a broader package of investment in water non-infrastructure which will reduce the risk of water supply interruptions to our customers. As part of our Water Criticality Framework[12],

[12] Our Water Criticality Framework is a resilience assessment tool which assesses the relative ability of other assets within the water network to mitigate a supply interruption. It calculates the likely volume of properties being served by that site that would be impacted by such an event

we've identified the strategically important sites to our overall supply. This, coupled with power alarm data, has identified the sites in greatest need of additional redundancy resilience.

## 7.4 Water power resilience – our response to feedback on need for enhancement investment

Ofwat's deep dive assessment stated:

- "The company **does not set out what the baseline risk position is**, by **how much it is increasing**, and **why the proposed scale of investment is the right level** required to manage the increasing risk."
- "The company **does not provide sufficient and convincing evidence that there is an increasing risk from hazards outside of its control**."
- "The company states that the ri**sk of power outage is increasing due to climate change impact and the changing mix of electricity grid sources due to de-carbonisation**. However, they **do not provide sufficient and convincing evidence of the timeliness of this shift in energy policy driven change**."

As previously described in the October submission, the response to power query "OFW-OBQ-SRN-211 – Power Resilience" and the additional information on the need for investment in wastewater power resilience solutions, the need for investment in our water network is being driven by our need to build redundancy against the threat of power supply interruptions from our DNOs due to storm events and heat stress impact on their assets.

### *Lessons learnt from these storm events*

One of the crucial findings from reviewing our response to storm events was that [redacted].

Over the past 5 years, the UK has been impacted by 33 'named' storms. The criteria used for naming storms is based on the Met Office's 'National Severe Weather Warnings service'. This is based on a combination of both the impact the weather may have, and the likelihood of those impacts occurring. A storm will be named when it has the potential to cause an amber or red warning.

As previously highlighted through the UK Met Office climate change projections update (UKCP18), it is widely accepted that the frequency and magnitude of extreme weather events will continue to increase. These same projections have been used in Ofwat's common reference scenarios for climate change and are the basis for the Ofwat selected Representative Concentration Pathways (RCPs) 2.6 and 8.5[13]. Under these scenarios, extreme weather events are expected to increase in frequency, and we consider our proposals as a demonstration of our intention to invest in the right long-term solutions, collaborate and work with nature to deliver better outcomes, enhance our resilience and protect and improve the environment.

[13] PR24 and beyond: Long-term delivery strategies and common reference scenarios – Section 3.2.1 Climate Change

The need to undertake enhancements of our critical sites is further supported by National Security Strategy (NSS) to improve the resilience of critical infrastructure. The cabinet office's "Keeping the Country Running: Natural Hazards & Infrastructure"14 documents the UK government's desire to encourage an "ability in organisations and their infrastructure networks and systems to absorb shocks and recover; and enabling an effective local and national response to emergencies".

Learning lessons from these storm events has shown us the strategic importance of building redundancy, resistance and reliability into the power systems at our critical sites to enable us to continue to provide our essential services to customers and protect the environment during significant storm events when our DNOs suffer power outages.

**Thorough our monitoring and continuous improvement activities and learning from past experiences we have identified a need to enhance our power infrastructure across our water and wastewater network.**

## *Additional information on the risks associated with storm events*

Between our submission in October 2023 and draft determinations, we responded to query "OFW-OBQ-SRN-211 – Power Resilience" to provide additional information and evidence on the baseline risk position, how it is increasing and why the scale of the proposed investment is appropriate.

The following section summarises the key findings and evidence from our October submission and the query response.

### Operational risk and impact

Our baseline risk position for our power resilience investment is based on the fact we have been impacted by 33 named storms during the past 5 years. This has resulted in 414 pollution events and led to a significant number of customer water supply incidents.

### How is the risk increasing

In our query response from February2024 we provided additional information on how variability in frequency and severity of storm events is providing an increasing level of risk to our power infrastructure which is outside our control.

### Storm events

The UK Meteorological Office climate change projections update (UKCP18) states the UK climate will continue to be characterised by warmer, wetter winters and hotter, drier summers, accompanied by an increase in the frequency and magnitude of extreme weather events.

In the UK, the Met Office will name a storm under the following criteria:

*"In the UK a storm will be named when it has the potential to cause disruption or damage which could result in an amber or red warning. This is based on our National Severe Weather Warnings service, which is a*

[14] Cabinet Office "Keeping the Country Running: Natural Hazards and Infrastructure"

*combination of both the impact the weather may have, and the likelihood of those impacts occurring. Storms will usually be named on the basis of the impacts from strong winds"15*
Each year the UK is impacted by many storms which meet these criteria, each of which brings risks of damage to the UK's electricity networks, which can then impact our operations through loss of uninterrupted power supplies. To protect our operations, and our services to our customers and the environment, we need to build resilience into our power infrastructure systems under these conditions.

Figure 8 and Table 26 show additional statistics on the number of named storms in the UK, since the naming convention and criteria were introduced. This data shows significant annual variability of named storms in the UK and, when combined with our learnt experiences, specifically from the storm events in 2022, we have seen an upturn in the severity of the storms resulting in significant impacts on our operations. Since our submission in October 2023, the UK has had 9 named storms, more than double the number in 2022/23.

Additionally, when assessed in conjunction with the UK Government's focus on ensuring our critical infrastructure is resilient, this strengthens the need for us to be able to cope with 8-11 storms every 8 years, against a current baseline of being able to manage between 4 and 7 on an annual basis. We now need to prepare for more storms and there is no guarantee we will be able to hire generators in good time to ensure customers do not lose water supply and we do not cause pollution events.

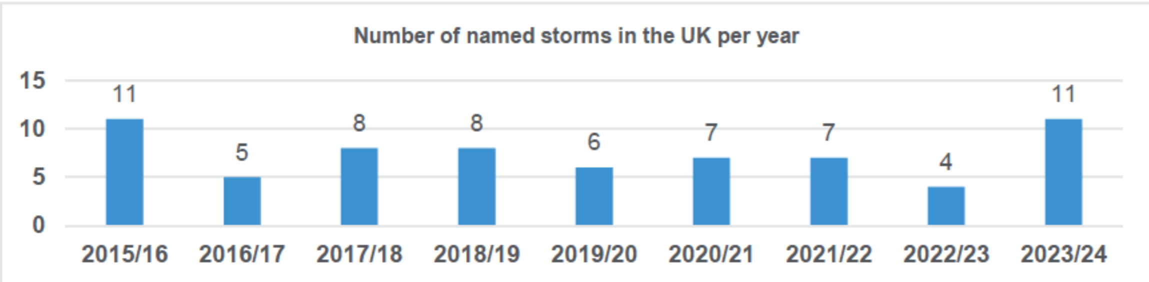


**Figure 8: Annual number of UK Named Storms 2015/16 - 2023/24**

| Year | No. Named Storms | Names of Storms | Source |
|---|---|---|---|
| 2023/24 | 11* | Agnes, Baber, Ciaran, Debi, Elin, Fergus, Gerrit, Henk, Isha, Jocelyn, Kathleen | UK Storm Centre - Met Office |
| 2022/23 | 4 | Otto, Noa, Antoni, Betty | UK Storm Season 2022/23 - Met Office |
| 2021/22 | 7 | Arwen, Barra, Malik, Corrie, Dudley, Eunice, Franklin | UK storm season 2021/22 - Met Office |
| 2020/21 | 7 | Alex, Barbara, Aiden, Bella, Christoph, Darcy, Evert | UK Storm Season 2020/21 - Met Office |
| 2019/20 | 6 | Atiyah, Brendan, Ciara, Dennis, Jorge, Ellen, Francis | UK storm season 2019/20 - Met Office |

15 UK Storm Centre - Met Office

| | | | |
|---|---|---|---|
| 2018/19 | 8 | Ali, Bronagh, Callum, Deirdre, Erik, Freya, Gareth, Hannah | UK storm season 2018/19 - Met Office |
| 2017/18 | 8 | Aileen, Ex-Hurricane Ophelia, Brian, Caroline, Dylan, Eleanor, Fionn, David, Georgina, Hector | UK storm season 2017/18 - Met Office |
| 2016/17 | 5 | Angus, Barbara, Conor, Doris, Ewan | UK storm season 2016/17 - Met Office |
| 2015/16 | 11 | Abigail, Barney, Clodagh, Desmond, Eva, Frank, Gertrude, Henry, Imogen, Jake, Katie | UK storm season 2015/16 - Met Office |

**Table 26: Annual Number of UK Named Storms and associated details**

The Met Office states that trends in windstorm numbers are difficult to detect, due to how these naturally vary year-to-year and decade-to-decade[16]. But research in the UKCP18 Storms Factsheet[17] suggests that across the UK, winter storms are likely to increase in both frequency and severity towards the end of the century. Figure 9 shows the relevant snapshot from the Factsheet report, and associated text.

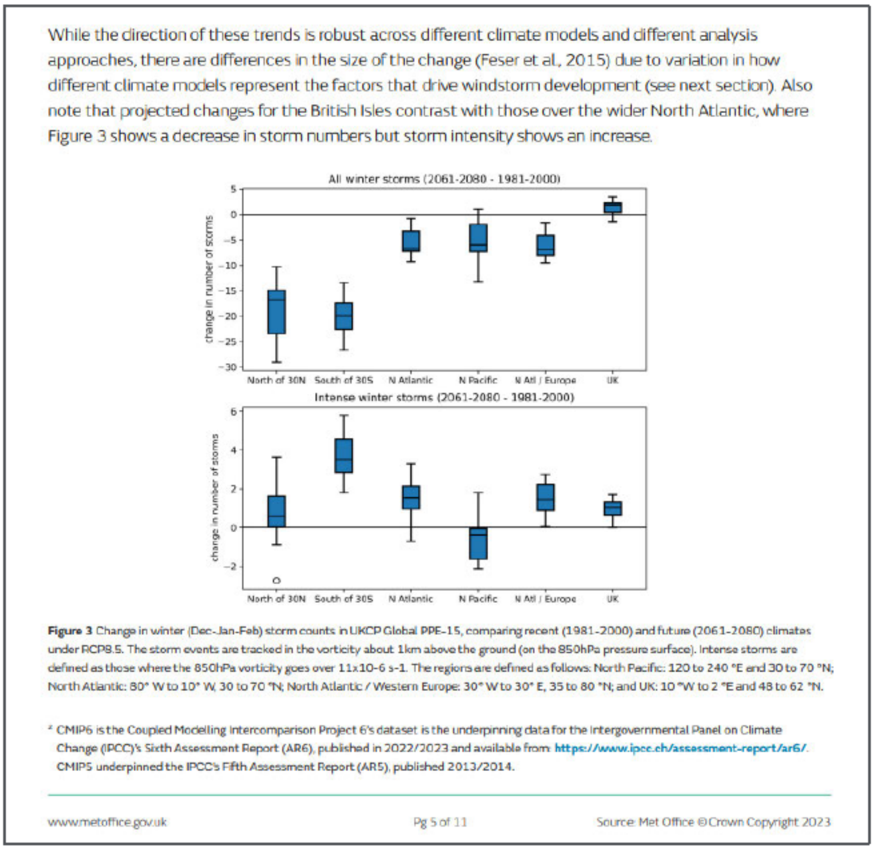
While the direction of these trends is robust across different climate models and different analysis approaches, there are differences in the size of the change (Feser et al., 2015) due to variation in how different climate models represent the factors that drive windstorm development (see next section). Also note that projected changes for the British Isles contrast with those over the wider North Atlantic, where Figure 3 shows a decrease in storm numbers but storm intensity shows an increase.



**Figure 3** Change in winter (Dec-Jan-Feb) storm counts in UKCP Global PPE-15, comparing recent (1981-2000) and future (2061-2080) climates under RCP8.5. The storm events are tracked in the vorticity about 1km above the ground (on the 850hPa pressure surface). Intense storms are defined as those where the 850hPa vorticity goes over 11x10-6 s-1. The regions are defined as follows: North Pacific: 120 to 240 °E and 30 to 70 °N; North Atlantic: 80° W to 10° W, 30 to 70 °N; North Atlantic / Western Europe: 30° W to 30° E, 35 to 80 °N; and UK: 10 °W to 2 °E and 48 to 62 °N.

[2] CMIP6 is the Coupled Modelling Intercomparison Project 6's dataset is the underpinning data for the Intergovernmental Panel on Climate Change (IPCC)'s Sixth Assessment Report (AR6), published in 2022/2023 and available from: https://www.ipcc.ch/assessment-report/ar6/. CMIP5 underpinned the IPCC's Fifth Assessment Report (AR5), published 2013/2014.

www.metoffice.gov.uk Pg 5 of 11 Source: Met Office © Crown Copyright 2023

**Figure 9: Snapshot of UKCP18 Storm Factsheet indicating predicted future storm frequency and severity**

16 UK Storm Centre - Met Office
17 ukcp18-factsheet-storms.pdf (metoffice.gov.uk)

### *Increasing risk outside of our control and worsening climatic position – increasing temperatures*

Power system assets are at risk from increasing temperatures. The evidence and information presented at the start of our response is equally relevant to describing the need for this investment, as we also need to invest to increase the resilience of our power system assets in our water system.

We have provided additional evidence on our research to describe the associated risks is provided at the start of this document.

## 7.5 Water power resilience – our response to your feedback on best options for customer

Ofwat's deep dive assessment, included comments on:

- *The choice of options presented relates to* ***different scales of programme*** *as* ***opposed to different options****.*
- *The benefit calculations are shown in the context of a Service Measure Framework. However, the company* ***presents the benefits for the chosen solution only****, and the* ***main components of the scheme do not appear to be cost beneficial.***
- *The company states that* ***standby generator schemes carbon and operational costs have currently been assessed to be negligible*** *because they will be used by exception in emergencies. This approach does not consider embedded carbon and could lead to best value solutions being overlooked. There is not sufficient and convincing evidence that the best option has been selected.*

Installing standby generators at critical sites in our water network will build operational redundancy at these sites and ensure that they have suitable and sufficient power supplies to operate each site even during DNO blackout conditions. This is a slightly different need and outcome compared to our wastewater power resilience investment, where we are increasing the resistance, reliability and redundancy as a result of significant environmental issues impacting a specific geographical area.

### Alternative solution types considered

Alongside our proposed standby generator schemes we also considered options to install dual transformers and upgrade our power systems to operate as HV rings for our water sites. These alternative solutions require further engagement with our DNOs, which alongside the supporting information below, formed part of our decision to prioritise the investment in fixed standby generators.

In previous power resilience investigations the requirement to have operational fixed standby generators has formed part of our resilience terms of reference, as we understand how important it is for our sites to have back-up power supplies available, to continue to function, when we experience power outages with the electrical distribution networks.

Prioritising our standby generator solution will help us address our areas of highest short-term risk, whilst balancing the costs for our customers, allowing us to deliver significant improvements to our performance, affordably.

However, we still recognise that the HV Ring and Dual Transformer schemes will be critical to enhance our long-term power resilience and as such we plan to carry out additional investigations into these schemes with a view to incorporate them in our Long-Term Delivery Strategy (LTDS) and future AMPs. This will help us work with DNOs and other stakeholders to plan and deliver power resilience solutions that deliver long-term benefits for the environment and our customers across our network.

For this particular solution, for the reasons listed above, the associated embedded carbon cost were not considered to have a material impact in the appropriateness of the solution.

## Revised site selection

Since our October submission, we have further developed the scope of works to upgrade each site. This has led to updated costs for each site and meant we have had to prioritise specific sites to be enhanced through the climate resilience uplift mechanism.

Table 27 provides information on the:

- Site specific power requirements, to install appropriately sized generators that can power the whole site
- Updated costs for the generators and associated works at each site
    - the updated direct costs have been externally benchmarked and have had updated cost multipliers applied
- Site prioritisation criteria:
    - Number of properties at risk of water supply interruptions; and
    - Historical number of power alarms
- Site specific and accumulated benefits

These decisions we have made on which sites to prioritise have been made with the guidance of the 0.7% base allowance for the climate resilience uplift mechanism, to prioritise this investment at our most impactful sites.

**Sites being progressed**

- [redacted] all have more than 10000 properties at risk and have experienced many power alarm faults over the past 5 years.

**Sites not being progressed**

- [redacted] are not being progressed due to there being 0 Properties at risk from these sites, due to inter-network connectivity within the Water Resource Zone.
- [redacted] are not being progressed due to the relatively low numbers of properties at risk of supply interruptions and the associated smaller scale of benefits.

| Water Climate resilience uplift mechanism - Site Prioritisation | | | | | | | |
|---|---|---|---|---|---|---|---|
| Site | Required Gen Size (costed by CIT) | Full Stack Costs | Accumulated Costs | Properties at Risk | Power Alarms over 5-year period | Total Benefit | Accumulated Benefit |
| [redacted] | 750kVA | £1,166,651 | **£1,166,651** | 35776 | 25 | £1,788,800 | £1,788,800 |
| | 100kVA | £354,062 | **£1,520,713** | 14021 | 27 | £757,134 | £2,545,934 |
| | 1250kVA (Hampers Lane WSR/WBS) | £2,096,106 | **£3,616,818** | 43936 | 7 | £615,104 | £3,161,038 |
| | 750kVA | £1,166,651 | **£4,783,469** | 12485 | 19 | £474,430 | £3,635,468 |
| | 750kVA | £1,166,651 | **£5,950,120** | 21808 | 7 | £305,312 | £3,940,780 |
| | 1250kVA (Sandown WSW) | £1,288,925 | **£7,239,045** | 2089 | 35 | £146,230 | £4,087,010 |
| | 750kVA | £1,166,651 | **£8,405,696** | 2863 | 6 | £34,356 | £4,121,366 |
| | 1870kVA (Balsdean WSW) | £2,293,192 | **£10,698,888** | 0 | 18 | £0 | £4,121,366 |
| | 250kVA | £460,412 | **£11,159,300** | 0 | 85 | £0 | £4,121,366 |
| Totals | | **£11,159,300** | **£11,159,300** | | | **£4,121,366** | **£4,121,366** |

**Table 27: Water power site prioritisation**

## 7.6 Water power resilience – our response to your feedback on cost efficiency

Ofwat's deep dive assessment, stated:

- The company **does not provide sufficient and convincing evidence that the costs are efficient**.
- The company **does not provide evidence of cost benchmarking or evidence that costs have been externally assured**.

Since our October submission, our Engineering and Cost Intelligence teams have reviewed and revised the scope of work for each site and provided updated cost estimates. This has included re-assessing the amount of power required to operate the whole site in the event of interruptions to the DNO supplies. These updated cost estimates have been externally benchmarked by Mott MacDonald.

These site specific designs have increased the costs at each site, and as such we have made the decision to prioritise our investment to reduce the costs for our customers while targeting our interventions at the highest risk sites.

### *External cost benchmarking*

Since October and through additional support from our Engineering team, Mott MacDonald has carried out cost benchmarking for the generator sizes required at each site.

### Benchmarking findings and key facts

- Externally benchmarked costs have been provided for 7 generator sizes and associated works
  - All sites have over 98.99% scope coverage.
- The variances primarily fall within an acceptable tolerance for this level of design definition and range between -22.81% and 21.75% except for the 100kVA option. This has a larger variance at -31.37% which is in part due to a larger proportion of the scope being attributed to items which have smaller drivers.
- We provided Mott MacDonald with an updated scope of works for each site.
- The benchmark has been generated using Mott MacDonald's custom benchmarking tools which ensure consistent alignment of benchmark sources across individual assets and models.
- Data used to complete the benchmarking has been gathered from data from 8 comparable water companies.
- Costs were normalised with respect to inflation using the CPIH inflation index.
- Price base is set to 1Q2023.
- Costs have been normalised with respect to the construction location, helping mitigate the effects of regional purchasing power to improve the benchmark accuracy.

| Sites taken forward | Generator Size and Costed Scope | Total Scope | Scope Benchmarked | Quotation Cost | Coverage | Benchmark | Variance |
|---|---|---|---|---|---|---|---|
| [redacted] | 750kVA | £584,319.75 | £578,400.42 | £- | 98.99% | £574,366.31 | 0.70% |
| | 100kVA | £177,332.50 | £153,172.27 | £22,460.00 | 99.04% | £255,924.49 | -31.74% |
| | 1250kVA (Hampers Lane WSR/WBS) | £1,049,839.12 | £1,043,919.79 | £- | 99.44% | £857,393.86 | 21.75% |
| | 750kVA | £584,319.75 | £578,400.42 | £- | 98.99% | £574,366.31 | 0.70% |
| | 750kVA | £584,319.75 | £578,400.42 | £- | 98.99% | £574,366.31 | 0.70% |
| **Sites not taken forward** | | | | | | | |
| [redacted] | 1250kVA (Sandown WSW) | £645,561.01 | £639,641.67 | £- | 99.08% | £607,374.45 | 5.31% |
| | 750kVA | £584,319.75 | £578,400.42 | £- | 98.99% | £574,366.31 | 0.70% |
| | 1870kVA (Balsdean WSW) | £1,148,550.43 | £1,142,631.10 | £- | 99.48% | £1,007,886.63 | 13.37% |
| | 250kVA | £230,598.19 | £201,945.97 | £26,952.00 | 99.26% | £296,525.59 | -22.81% |

**Table 28: Updated, benchmarked costs for each site**

## *Changes in cost from our October submission*

Our proposed costs for our power related climate resilience investments have changed since October for two main reasons:

- More accurate cost estimates for the works to be delivered at specific sites.
- Reduction in the number of sites where interventions are being made (prioritising 5 of our 9 original sites) to balance financial pressures with site specific operational risks; and
- Reduction in risk cost multipliers based on our increased confidence in design maturity and implementation complexity.

We have revised our cost multipliers for our standby generator schemes based on the increased confidence we have in the site-specific requirements and implementation complexity.

### Cost multiplier changes

| | Design Maturity | Complexity | Risk (%) |
|---|---|---|---|
| October 2023 Submission | Medium | Medium | 7.0% |
| **Latest, August 2024** | **High** | **High** | **1.3%** |

**Table 29: Standby generator risk cost multiplier ratings**

### Updated cost multiplier impact

| | Direct Cost | Indirect Cost | Risk | Corporate Overhead | Total |
|---|---|---|---|---|---|
| October 2023 Submission | 100.0% | 76.5% | 7.0% | 11.7% | 2.11 |
| **Latest, August 2024** | **100.0%** | **76.5%** | **1.3%** | **11.7%** | **2.00** |

**Table 30: Standby Generator power resilience enhancement scheme cost multiplier breakdown**

The standby generator resilience schemes' cost multipliers are based on the following criteria:

- The scheme involves delivery of **non-infrastructure** projects.
- The scheme is to be **'traditionally funded'.**
- We have h**igh degrees of confidence in design maturity and complexity** for the activity to be delivered at each site.

### *Programme scale changes due to refined scope and updated cost multipliers for our water standby generator schemes*

The result of these decisions is **we are now requesting £5.95m to invest to improve our power resilience in AMP 8 through installing fixed standby generators at 5 sites**. This is an increase of £1.14m from the **£4.81m we originally requested in October for our water sites.**

## 7.7 Water heat stress resilience – additional information on plan

We are not proposing to make any changes to our plan to invest in heat stress solutions at two of our water supply works, but we have provided additional evidence to respond to the feedback received from the deep dive carried out as part of the draft determination.

## 7.8 Water heat stress resilience – additional information on the need for enhancement investment

Ofwat's deep dive assessment, stated:

- The company does not provide sufficient and convincing evidence that there is an increasing risk from hazards outside of its control.
- It has not explored a worsening climatic position (or increasing risk scenario).The company presents current risks from the recent hot summer of 2022 without projecting into the future or properly linking to assets or service impacts.
- The company does not provide sufficient and convincing evidence that the risk is increasing in the future or that the risk is a new risk, not covered by the implicit allowance.

Additional information on the increasing level of climate risk and worsening climatic position is provided in our additional evidence on climate change risk scenarios at the start of this document. This includes the risk and likelihood of increased extreme temperatures in our region by 2070.

We have provided additional evidence on our research to describe the associated risks is provided in at the start of this document, with key findings from our climate change risk assessment provided below:
Our asset heat stress risk assessment considered the following climate change scenarios and future time periods.

The heat stress assessment considered a future **time horizon of 2070** and used extreme **summer temperature data from Representative Concentration Pathway (RCP) 8.5.**

The result of this assessment is illustrated in Figure 10 that shows maximum air temperatures across our operational region as being between 38-40 degrees Celsius during summer conditions by 2070.

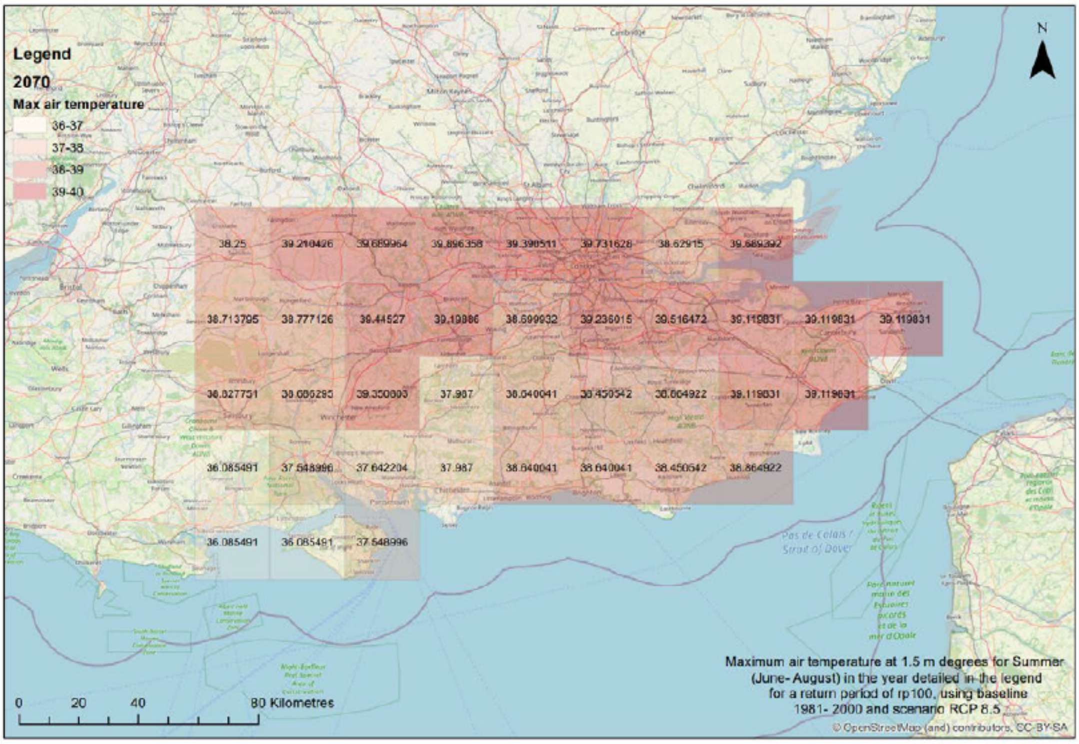


**Figure 10: Maximum forecast air temperature for South East England in 2070 under RCP 8.5**

We need to make interventions in our operational asset base to allow us to function and operate under these worsening climatic conditions. The selected UKCP18, CCC report (2021) as presented in our Climate Change Adaptation Report 2021 stated the following projections around average annual temperature rises shown in Table 31.

| Average annual temperature rise metrics | 2°C warming | 4 °C warming |
|---|---|---|
| UK annual average temperature increases (2080) | 0.7°C | 3.0°C |
| Average summer temperature increase (South East) | 3-4°C | 4-6 °C |
| UK heatwave (like 2018) (2100) | 50% chance each year | 90% chance each year |

**Table 31: Average annual temperature risk metric under UKCP18 scenarios from our Climate Change Adaptation Report (2021)** [18]

This insight from the UKCP18 data supports the understanding that the South East is facing a significant increase in annual temperatures because of climate change which poses a significant risk to our assets.

[18] https://www.southernwater.co.uk/about-us/environmental-performance/protecting-and-improving-our-environment/climate-change-adaptation-report/

Without investing to enhance the resilience of our most critical works to the increasing heat stress risk, we can expect to see more operational issues that will impact customer and environmental performance as more of our assets are affected by increasing temperatures in our region and having to operate outside of their designed operational standards.

## 7.9 Water heat stress resilience – additional information on best option for customers

Ofwat's deep dive assessment, stated:

- The company does not provide evidence that it has considered **an appropriate range of options or the methodology for scoring of the proposed options**.
- It **presented the service impact calculation for option 4 only.**
- It **does not provide evidence of cost benefit analysis for all solutions**.

In our October submission, we provided 4 options, with Option 4 being our proposed solution. This option consists of the following enhancement activities:

- Installing temperature monitoring devices at our selected sites
- Changing site configuration to ensure existing and future high-heat equipment have suitable cooling and ventilation requirements
- Installing air conditioning in existing kiosks and buildings hosting high-heat producing equipment

### Additional evidence and information on the cost benefit analysis options

Whilst the cost/benefit analysis was not explicitly stated on all 4 options, we provided rationale for excluding the:

- Do Minimum option (Option 2) based on a combination of Safety and Security risks; and
- Do More option (Option 3) based on expert input from our Operations and Engineering teams, whilst also viewing the activities under this option to be more base maintenance activity.

The costs for our Do Nothing option (Option 1) was described through the cost of renting portable air conditioning unites for a typical site for a period of 60 days, assumed to be the hottest part of the year. This led to a cost of £150k per site. This option was discounted as it is a purely reactive operational cost and does nothing to build resilience against the increasing threat posed by climate change induced temperature rises.

These assessments led us to the decision to progress Option 4 through enhancement funding, as it proposes a permanent solution that helps us prepare to operate more effectively with increased and extreme ambient temperatures that we are experiencing due to climate change.

## 7.10 Water heat stress resilience – additional information on cost efficiency

Ofwat's deep dive assessment, stated:

- The company **does not provide sufficient and convincing evidence that the proposed cost is efficient**.
- The company states it has used engineering consultants to develop initial scope of proposed solution options and fed into a climate change adaption tool. The company states that it has benchmarked the costs.

- The company **does not provide any evidence of benchmarking**. The company **does not provide evidence of external assurance of costs**.

## *Our response to the cost efficiency challenge*

We recognise the minor concerns you stated on our plan as part of the draft determination deep dive and **we have accordingly applied a 10% cost efficiency on our schemes.**

Our costs for the Heat Stress solutions were developed by Mott MacDonald who developed our *'Southern Water Climate Change Adaptation Costing Tool'* to estimate the costs associated with our AMP 8 solutions.

This tool was developed and operated by Mott MacDonald and used a variety of data sources, listed below:

- Southern Water top-down cost models (cost curves),
- Industry top-down cost models (cost curves);
- bottom-up, benchmarked cost rates from the Mott MacDonald database; and
- Early-stage contractor quotes

**This tool and the same approach was applied to both Flooding and Heat Stress solution cost estimates.**

**As our tool used independent cost benchmarking data from Motts MacDonald as part of the methodology to develop the cost estimates for the proposed solutions. We believe this should alleviate some of your concern that the solutions costs had not been benchmarked or assured.**

# 8. Business Plan Dependencies

This submission is directly related to the following enhancement cases:

- SRN 49 – Power
- SRN 51 – Heat Stress
- SRN 52 – Flooding

| Chapters | None |
|---|---|

Data Tables impacted by the representation:

| Table/s Impacted | Data Lines Impacted |
|---|---|
| CW3 | 118 Resilience; enhancement water capex |
| CWW3 | 168 Resilience; enhancement wastewater capex |
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**All documents and tables referenced above can be found on our website here: Business Plan 2025-30 - Southern Water**