

# SVE4.19 Power and Flood Resilience

Draft Determination representation

28 August 2024

WONDERFUL ON TAP



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# 1. Executive Summary

## Background

Severn Trent's PR24 business plan proposed a total of £49.82m for climate change resilience in both water and wastewater, addressing the increasing risks and impacts associated with fluvial and pluvial flooding resilience on our infrastructure and protect the services we provide to customers. Our case for wastewater enhancement investment is based on our Drainage and Wastewater Management Plan (DWMP), utilising the latest Met Office guidance on climate change impacts on the resilience of our services. Whilst our water resilience investment is based on risk analysis using Environment Agency flood risk maps.

## Ofwat challenge

Section 3.7.2 of the [Draft Determination Expenditure Allowances](#) document sets out the decisions related to climate change resilience. The draft determination does not allow for specific enhancement investment for pluvial/fluvial flooding or power resilience expenditure, on the basis that climate change resilience is funded through base allowance. Instead, Ofwat has allowed a conditional climate change resilience uplift based on 0.7% of a company's modelled base allowance, for companies to prioritise their biggest climate-related risks. For Severn Trent, this conditional allowance equates to £19.6 million for water and £21.2 million for wastewater.

Additionally, Ofwat states that the funding should, "as a minimum, address additional flood and power resilience requirements from climate change" and that "companies must set out what schemes they will deliver for the additional uplift funding in their representations. This should include details of the schemes and why these have been prioritised. If companies do not present suitable schemes with clear deliverables for the uplift allowance it will be removed from allowances at final determination."

## Why it matters

Given the growing frequency and intensity of extreme weather events due to climate change, it is critical to invest in measures that enhance resilience to these hazards. Whilst the 0.7% climate change resilience fund is welcomed, and we recognise there are pressures on customers' bills, our evidence shows that this will not be sufficient to ensure we can continue to meet our statutory obligations to enhance climate resilience to protect our customers to the level expected.

There is clear evidence from the Met Office in the various climate change scenarios (RCP6.0 and RCP8.5) that the impact of climate change is accelerating, and so without additional investment, historic levels of base investment are not expected to be sufficient to maintain tighter levels of resilience to meet customer expectations and protect the environment.

The impact climate change will have on our flooding risk includes:

- **Increased Rainfall Intensity:** Climate change is leading to more intense and frequent heavy rainfall events. For example, the UK Met Office found that heavy rainfall events like Storm

Desmond, which affected Northern England and Southern Scotland in December 2015, have become about 40% more likely due to climate change<sup>1</sup>.

- **Increased Flood Risk:** Studies have shown that the risk of river and surface water flooding is rising. For instance, research indicates that the annual damage caused by flooding in the UK could increase by more than 20% over the next century if current climate trends continue. For instance, research indicates that the annual damage caused by flooding in the UK could increase by more than 20% over the next century if current climate trends continue<sup>2</sup>.

### How to fix it

Following the draft determination, we have re-prioritised our water and wastewater climate change resilience activities, targeting our investment towards maximum risk reduction (and therefore customer benefit) during AMP8. We will also need to increase investment levels post AMP8 to ensure we can address the step change in climate change risk.

In Appendices A-C, we set out the schemes we will deliver for the additional uplift funding. These go beyond the allowed uplift funding for wastewater, but align with the DD for water:

- **15 priority water resilience schemes totalling £19.60 million**, in line with the uplift funding allowance for water (Appendix A).
- **13 priority wastewater resilience schemes totalling £30.22 million.** Section 4.2 details our view that base allowance is not sufficient to keep pace with the increasing impacts of climate change. This comprises of £0.89m for 3 asset specific resilience enhancements (Appendix B), plus we have defined a programme of investment worth £137.2m, of which £107.9m (79%) will come from third-party funding contributions (see Appendix C). We therefore propose a total of £30.22m of wastewater enhancement investment for 10 schemes (£9.02m more than the uplift funding allowance for wastewater) to unlock this third-party funding to facilitate wider resilience benefits from working together with partners. As the water investment request will address climate risks associated with fluvial flooding, third party funding cannot be accessed for water schemes.

Our prioritisation of schemes has focused on small-scale targeting of assets impacted by pluvial/fluvial inundation (i.e. flooding to distribution booster stations and boreholes, risks to water supply, and risks to wastewater pumping stations) rather than major improvements to a single asset type or geographical area, along with wider resilience scheme partnerships that are mature and ready to deliver. Our approach therefore targets investment at smaller vulnerable assets not previously subject to investment, where investment can provide maximum risk reduction and therefore customer benefit. We have prioritised our partnership funded flood resilience schemes following consultation with partners to maximise the wider benefits of co-funded solutions.

This document is structured using the evidence criteria described in Section 3.7.2 of the draft determination. We have followed the concept that funding should be targeted on flood and power resilience and that companies must set out what schemes they will deliver for the additional uplift

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<sup>1</sup> <https://www.lse.ac.uk/granthaminstitute/explainers/how-is-climate-change-affecting-river-and-surface-water-flooding-in-the-uk/>

<sup>2</sup> <https://www.lse.ac.uk/granthaminstitute/explainers/how-is-climate-change-affecting-river-and-surface-water-flooding-in-the-uk/>

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funding in their representations, including details of the schemes and why these have been prioritised. Section 7 outlines our proposed Price Control Deliverable (PCD), through which we will be held accountable for performance

## 2. Measurable climate impacts on assets or service levels

### 2.1 Types of climate change impact

Climate change has a number of impacts on our assets and the service levels we provide to customers. The intensity, duration, volume and frequency of storm events can lead to our assets being inundated by pluvial and/or fluvial flooding, whilst additionally high winds, extreme temperatures (both hot and cold) and lightning strikes can impact on electricity supplies or communication outages which impact on our ability to deliver expected levels of services.

These hazards are outside our control and affect our resilience of our water and wastewater services in several ways, outlined below.

#### Pluvial flooding resilience

Pluvial flooding resilience is resilience against flooding caused by heavy rainfall that does not infiltrate into the ground, but instead runs off the surface, leading to flash floods primarily in urban areas where drainage systems may be overwhelmed. Pluvial flooding is typically caused by intense rain events that exceed the capacity of the local drainage systems, which are exacerbated by climate change due to increased intensity, rainfall volume and frequency of storm events.

This can result in flooding to specific assets (e.g. distribution booster stations, boreholes, sewage pumping stations), and can also cause inundation on the sewerage network with flows we are not legally bound to receive (i.e. run-off from fields and other areas outside a sewerage undertakers' duties under Section 94 of Water Industry Act 1991). This can result in properties flooding from the sewerage network because capacity is being exceeded by inflow the sewerage network is not designed to convey.

There is clear evidence in our DWMP that the impact of climate change is accelerating, and that historic base investment is not sufficient to maintain resilience. Figure 22 in Section 5.5.1 (page 53) indicates the risk of flooding in a storm was predicted to increase under all climate change scenarios, whilst Figure 28 in Section 6.2.1 (page 65) shows the impact of different investment choices, with base investment levels showing a 21.4% increase in properties at risk by 2050.

Under the Flood and Water Management Act 2010, the Lead Local Flood Authority (LLFA) is primarily responsible for pluvial flooding but we recognise, particularly for wastewater, that working together can deliver wider resilience benefits.

#### Fluvial flooding resilience

Fluvial flooding resilience is resilience against flooding caused by rivers and streams overflowing their banks. Recent winter storms are resulting in this type of flooding becoming more frequent, deeper and more prolonged due to climate change. In addition to rivers directly flooding buildings and gardens, the same flood water can also inundate both water and wastewater assets. Whilst our water supply networks are 'sealed systems', wastewater assets are 'open systems' and so as well as directly inundating pumping stations, river flows can also overwhelm the sewerage system by using highway gullies and domestic drainage as flow pathways to inundate wastewater capacity.

Under the Flood and Water Management Act 2010, the Environment Agency are responsible for managing fluvial flood risk from designated Main Rivers, whereas riparian owners are responsible for risk emanating from Ordinary Watercourses.

## Power resilience

These risks are associated with climate change impacts affecting to electricity power supplies, where overhead powerlines could be impacted by high winds, hit by lightning, or electricity generation/distribution infrastructure impacted by pluvial or fluvial flooding. Whilst electricity power suppliers have a responsibility to ensure the resilience of the electricity infrastructure, the consequence of failure impacts on a sewerage undertaker's ability to effectively drain its catchment, or a water company's ability to provide a reliable drinking water supply. Where this can could impact on critical infrastructure, we work with the electricity power provider to reinforce the supply (such as provision of a backup supply from a different part of their network, undergrounding vulnerable overhead supplies) but may also require Severn Trent providing facilities to connect an emergency backup generator.

## Communication resilience

Similarly, climate change can also impact on communications, either by knocking out mobile phone networks or disrupting landline communications, and so these outages impact on our ability to remotely operate assets or an asset's ability to send status reports or flow/depth data. This could result from damage to overhead telecommunication wires, broadband disruption or interruptions to mobile telephony network signals. Not receiving alarms and/or signals also inhibits our ability to respond to asset outages, increasing the risk of water supply outages, flooding from the sewerage network, and environmental pollution.

## 2.2 Measurable impacts on water supply

The main ways we can measure the impacts on water service are:

- Supply interruptions, which is a measure of the customer impact (this is an all-encompassing measure and does not differentiate by the reason for the interruption).
- Works and asset outage is a measure of more localised flood impact.
- Raw water quality - particularly surface water, which is impacted by flooding and run-off into rivers. This makes it harder to treat the water, and could have a knock-on impact to the treatment works deployable output.

The number of supply interruptions due to flooding is extremely low and too small a sample size to draw any statistical relationships. We have invested in flood resilience at our highest risk assets, including Mythe water treatment works (WTW) following the severe flooding in 2007. Supply interruptions cause by hot weather is a significant and growing risk and is covered in our enhancement case 01: Resilient Water Networks<sup>3</sup>.

In our PR24 enhancement case 13: Raw Water Deterioration<sup>4</sup>, we set out the analysis we have been doing to better understand the link between climate change and raw water quality. This is emerging and not yet statistically significant but is an area we are increasing our understanding.

As water is essential to life, we cannot measure the impact of not providing sufficient levels of resilience by taking a reactive approach, with ever increasing reliance on contingency plans and operational interventions. Our approach has therefore reviewed the number of customers that would be affected should an asset be taken out of service due to climate induced hazards.

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<sup>3</sup> [https://www.stwater.co.uk/content/dam/stw/about\\_us/pr24/sve36-01-resilient-water-networks.pdf](https://www.stwater.co.uk/content/dam/stw/about_us/pr24/sve36-01-resilient-water-networks.pdf)

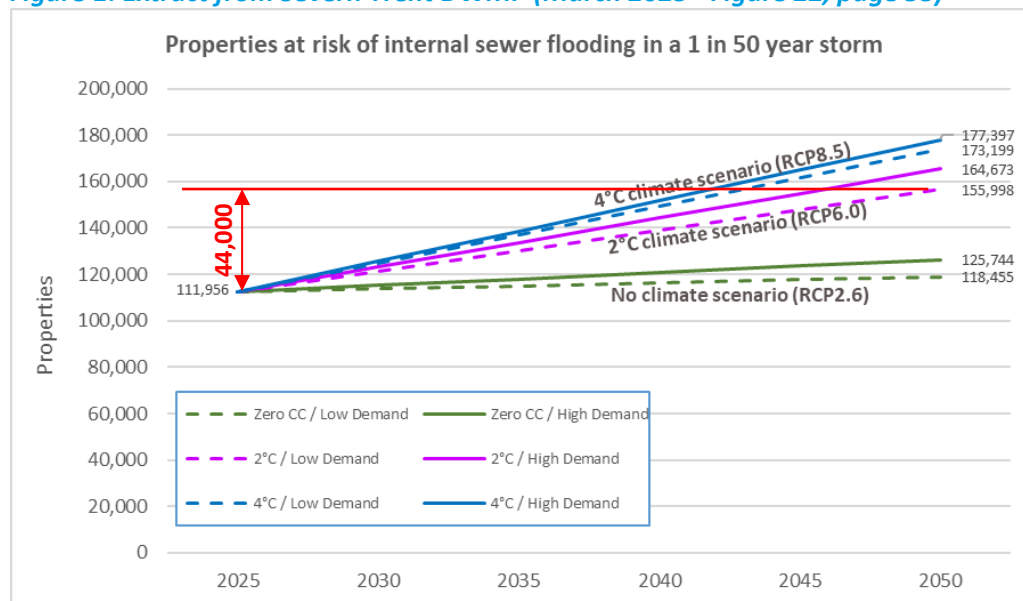
<sup>4</sup> [https://www.stwater.co.uk/content/dam/stw/about\\_us/pr24/sve29-13-raw-water-deterioration.pdf](https://www.stwater.co.uk/content/dam/stw/about_us/pr24/sve29-13-raw-water-deterioration.pdf)

## 2.3 Measurable impacts on wastewater

As outlined in more detail in Section 4 below, there is a demonstrable link between climate change and wastewater assets and service levels.

When it comes to risk from sewer flooding in a storm, our DWMP<sup>5</sup> indicates that base allowances are insufficient to mitigate the expected deterioration in the number of properties at risk of internal flooding associated with climate change and future demand. The graph in Figure 1 below, taken from our DWMP, indicates the 2°C / Low Demand scenario would see 44,000 more properties at risk by 2050 in a 1 in 50 year storm without enhanced resilience investment.

**Figure 1: Extract from Severn Trent DWMP (March 2023 - Figure 22, page 53)**



Since 2015, following the retirement of the DG5 Register by Ofwat, the Annual Performance Reports for sewer flooding incidents have only requested the total number of incidents, with no breakdown requested between incidents due to operational causes and those due to hydraulic overloading of sewer capacity (rainfall). Whilst we are seeing an overall reduction in incident numbers, we are seeing a steady increase in hydraulic incidents (i.e. those likely to have been exacerbated by climate change). Due to the nature of storm induced flooding and the sheer volume of flood water, these incidents have a greater impact on customers, both psychologically and financially, with the same customers being at risk until a long-term cost-effective intervention is in place.

The move to total incidents within a combined PC/ODI, this incentivises base allowance investment to have greater focus on simpler/quicker to resolve non-hydraulic incidents, ahead of more complex/harder to resolve hydraulic risks. Consequently the drive for efficiency and targeting overall reduction in flooding incident numbers has seen a steady reduction in investment in hydraulic incidents, as they are inherently more expensive, complex and take longer to resolve.

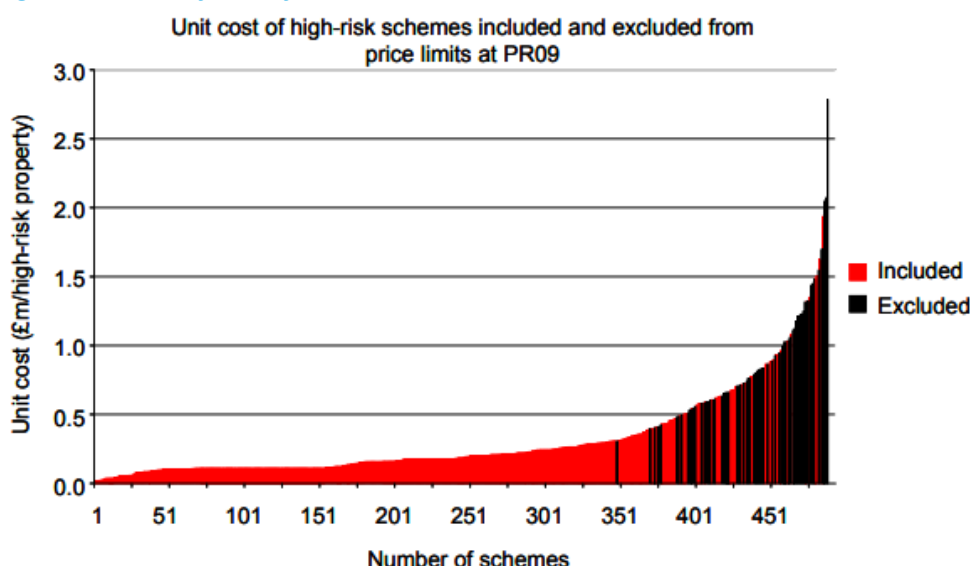
The PC/ODI incentivisation means the likelihood of a rainfall event causing a property to flood has increased as base investment is focused on other cause incidents to reduce overall incident numbers. This is not only evidenced in our DWMP, but also in our Hydraulic Flood Risk Register (HFRR), which replaced the old DG5 Register in 2015 and records all risk associated with flooding due to storm and thereby climate change. Our HFRR is based on actual incidents, with risk scores based

<sup>5</sup> [SVE-fdwmp23-L1-Non-Technical-Report.pdf \(severntrent.com\)](https://www.severntrent.com/sve-fdwmp23-l1-non-technical-report.pdf)

on severity and incident likelihood. We are seeing an ongoing increase in risk scores for internal property, garden curtilage and other areas. Additionally, using a replica of the old DG5 register criteria, the number of properties on the most frequent 2-in-10-year and 1-in-10-year DG5 categories has increased from 424 properties (2015) to 787 (today). This indicates the significance of the climate change impacts and that base investment levels have not have been sufficient to keep pace with more complex, high unit cost issues since the registers retirement. If base investment levels were sufficient to mitigate climate change, then we would be seeing steady levels of HFRR risks, not increasing levels of risk. This is despite our robust HFRR prioritisation methodology prioritising best value interventions to maximise the benefit to customers in the face of increasing climate change pressures.

Figure 2 is extracted from Ofwat’s PR09 Final Determination<sup>6</sup> (Figure 8, page 48) and indicates that more complex, high unit cost schemes were excluded from companies’ proposals in favour of lower unit cost schemes, with an expectation for companies to identify alternative solutions to emerging problems and keep customers informed of progress until the risk of flooding has been alleviated. Whilst actual incident numbers are being constrained by use of property-level mitigation measures (such as non-return valves and flood gates) these do not address the underlying incident risk.

**Figure 2: Extract from Ofwat PR09 Final Determination<sup>7</sup>**



Consequently, as the base allowance is based on lower unit cost schemes, with an expectation that ‘alternative solutions’ (such as temporary property level mitigation solutions) be used to alleviate higher unit cost problems, the underlying deterioration in risk due to climate change is being masked. Across Severn Trent’s region, around 70% of properties at risk of frequent sewer flooding have mitigation measures installed to protect properties from internal sewer flooding pending a permanent long-term solution, with a further 4% assessed but not feasible for short-term mitigation. Whilst some of the remaining 26% are in the process of being assessed to see if mitigation is viable, our mitigation programme is prioritised to take into account the likelihood of incident reoccurrence and its consequence. For example, known risks with low likelihood of reoccurrence and low impact, such as infrequent flooding to a garage, would have a lower priority for mitigation. Flood mitigation solutions are only stop-gap pending a long term solution (with mitigation requiring routine

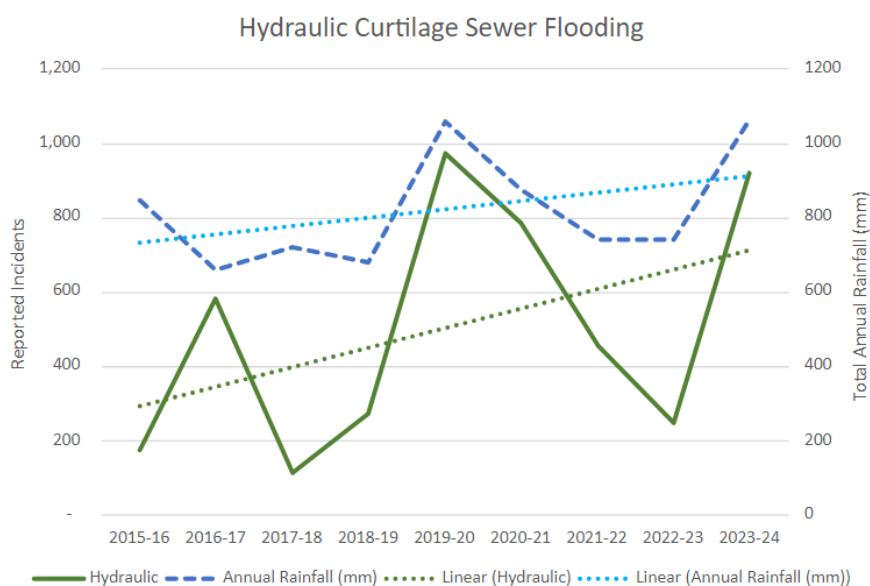
<sup>6</sup> [untitled \(ofwat.gov.uk\)](#)

<sup>7</sup> Source: Ofwat FD - Figure 8: Unit cost of high-risk schemes included and excluded from price limits at PR09

maintenance), and with climate change resulting in more frequent storms, with greater intensities and rainfall volumes, the risk of failure dramatically increases as the number of times they are being called upon is increasing

Pressure on base allowances, combined with incentives to focus on lower cost ‘other cause’ flooding and greater reliance on property level protection, is moving the problem to external garden curtilages. For example, installing flood doors on a property will mitigate the risk of internal flooding, but where the curtilage cannot practically be protected, future incidents will be recorded as ‘external’ instead of ‘internal’ as incidents reporting definition is based on the uses the worst impacted area. As pluvial flood paths are outside our control and getting more frequent due to climate change, this will result in more ‘un-mitigatable’ curtilage flooding incidents as open plan gardens don’t have boundary fences. Figure 3 below shows the number of reported hydraulic garden curtilage flooding incidents, together with the total annual rainfall. Whilst there is variability in specific years due to individual weather patterns/catchment characteristics (for example high incidents in 2016-17 associated with abnormally intense rainfall in June 2016 – 180% of the long-term monthly average), the addition of linear trendlines shows that the steady increase in rainfall totals is resulting in more external incidents. This is due to a combination of climate change and internal mitigation reclassifying previous the reported incidents o curtilage flooding.

**Figure 3: Graph showing hydraulic curtilage sewer flooding incident compared to total annual rainfall**



### 3. Quantifying consequence to prioritise investment

In this section we summarise the method we have taken to evidence we have identified the biggest risk. For water we see the risk of flooding causing equipment outages to be the greatest risk resulting in loss of supply to customers, whereby wastewater risks are dominated by opportunities to work with other risk management authorities to collectively work together to provide wider flood resilience benefits to our customers. We have prioritised our schemes based on the assets that could cause the greatest harm if left unchecked, either resulting in loss of supply or flooding to customers and the environment.

#### 3.1 Prioritising climate change resilience schemes

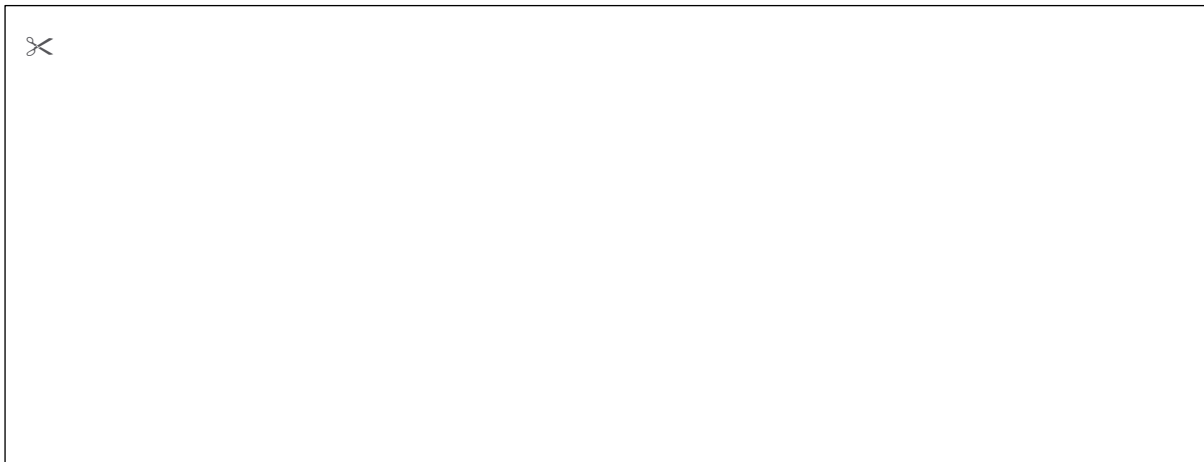
We reviewed our previous resilience assessments and the efficacy of previous flood protection investment to understand where the climate change has increased the risk to our sites and assets from river and surface water flooding. To do this we carried out the following methodology:

- Identifying asset/site data and location.
- Assessing asset criticality and impact of failure on customers.
- Identifying flood risk per asset/site – fluvial (river) and pluvial (surface water) flooding. We used the latest Environment Agency’s ‘Risk of Flooding from Surface Water (RoFSW)’ and ‘Risk of Flooding from Rivers and Seas (RoFRS)’ mapping layers. At present the Environment Agency does not publish future climate change flood risk maps to indicate future changes to flood extents, depths or frequencies.
- Overlaying actual recorded flood events data on a site-by-site basis (where this information exists) to appreciate the risk exposure to floods and efficacy of existing protection measures. Our approach to assess the resilience of our water infrastructure assets is in line with the 2016 National Flood Resilience Review. This considers the ability of key assets to maintain service during extreme flood events being exacerbated by climate change.

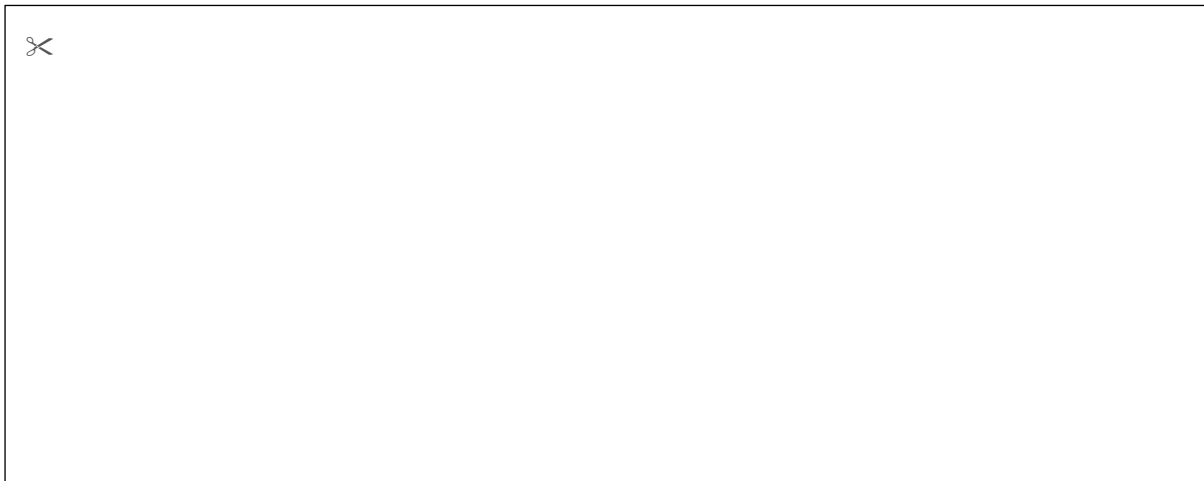
By overlaying location specific asset data with flood risk zones, we determined the assets at likelihood of failure and where this risk cannot be managed through operational contingency plans (such as over-tankering or temporary network reconfigurations). We then assessed the consequence to customers and the environment, such as loss of water supply, sewer flood risk or pollution. The maps below (Figure 4) show examples of how we have used fluvial and pluvial flood risk maps to identify assets at risk of inundation, thereby resulting in loss of service.

**Figure 4: Priority assets for climate change resilience activity (based on available EA flood risk maps)**

**Water asset resilience**



**Wastewater asset resilience**



**KEY:** Fluvial flood risk zones (pink) and pluvial flood risk zones (blue) identify assets at risk on inundation (% annual probability and water depth (m)).

### **3.2 Assessment of inundation to sewerage network from hazards outside our control**

Sewerage companies’ duties under Section 94 of the Water Industry Act 1991 do not extend to draining non-authorised inflow from sources we are not bound to receive (i.e. run-off from fields, increased pluvial inflow and river flooding). We are seeing an increase in the number of instances when exceptional events, such as those experienced from Storm Babet and Storm Henk, are resulting in our assets being inundated from fluvial and pluvial flooding. Whilst we have a good track record of working in partnership with other risk management authorities to manage such risks (as evidenced in Appendix 8 of our DWMP), base allowances are not sufficient to keep pace with the upward pressures we are seeing to maintain the resilience of our assets from unauthorised inflow due to climate change (again, evidenced in our DWMP). The sewerage network is not legally required to provide capacity to convey run-off not emanating from roofs, appertaining areas or

highways by agreement, yet climate change is increasing inflow from rivers and from saturated land drainage which previously would have soaked in the ground, but now runs overland into sewers (via highway gullies). These land drainage flows into the sewerage network are not authorised, yet can impact on our customers.

We have therefore reviewed where inundation from pluvial and fluvial interactions are causing impact to our customers, with the intention to work together to deliver multiple benefits. Taking a partnership approach provides future resilience to wastewater assets and drives efficiencies through co-creation of interventions.

## 4. Evidence that the risk or the improvement goes beyond what could be expected under base service

In this section, we provide evidence that the risk or improvement delivered by our water and wastewater schemes goes beyond what could be expected under base service, and should therefore be funded through enhancement investment.

In accordance with Ofwat investment definitions we have used the following criteria:

**Base expenditure** is routine, year-on-year expenditure, which companies incur in the normal running of their businesses to provide a base level of good service to customers and the environment. It includes expenditure to maintain the long-term capability of assets, as well as expenditure to improve efficiency.

**Enhancement expenditure** is generally where there is a permanent increase or step change in the current level of service to a new 'base' level and/or the provision to new customers of the current service. Enhancement funding can be for environmental improvements required to meet new legal obligations, improving service quality and resilience, and providing new solutions for water provision in drought conditions.

As this investment will provide a step change to increase historical levels of resilience they are not covered by base service.

### 4.1 Water resilience schemes

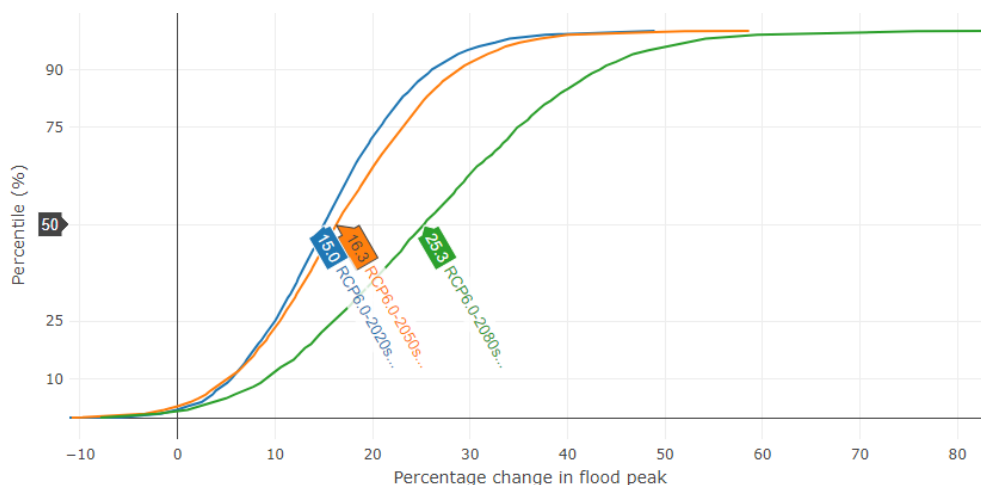
It is difficult to draw a clean line between what is expected to be delivered through base service (at no extra cost to customers) and enhancement. Typically, one-off large investments – such as the flood wall and protection around Mythe WTW, and the Birmingham Resilience Project - are treated as enhancements, and smaller-scale improvements are expected to be accommodated through base. There are many requirements that must be balanced within base spend, and the concern is that we are not able to keep pace with climate change whilst also delivering service improvements expected through the PC targets.

Across the UK, we are seeing more frequent extreme weather, which have been devastating for communities (e.g. Gloucester 2007, York 2015, Cumbria 2016), as well as an increase in prolonged wet weather periods that increase the risk of river flooding. Between September 2023 and April 2024, the Met Office named 11 storms forecast to have an impact upon the UK, of which Babet (October 2023) and Henk (January 2024) placed significant pressures on our asset resilience. Figure 5 below shows the cumulative distribution functions of the impacts of climate change on river flood peaks on the River Trent at Nottingham (UK Centre for Ecology & Hydrology<sup>8</sup>) showing greater frequency of future flood peaks due to climate change. Each line shows the cumulative distribution of the impacts of climate change on river flood peaks for a 50-year return period for different epochs (2020s: blue, 2050s: orange & 2080s: green) using a RCP6.0 (2°C) climate scenario. This shows that the using the 50th percentile, climate change is forecast to see the percentage change in flood peak due to increase from 15% 2020s to 16.3% by 2050, thereby increasing risk of river flood depth.

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<sup>8</sup> [Climate change impacts on river flood peaks | UK Centre for Ecology & Hydrology \(ceh.ac.uk\)](https://www.ceh.ac.uk/news/2023/09/2023-09-20-climate-change-impacts-on-river-flood-peaks)

**Figure 5: Graph showing the forecast percentage change in flood peak on the River Trent, Nottingham<sup>9</sup>**



To date, resilience investment has focussed on major WTWs with higher consequences of failure, putting increased pressure on contingency planning interventions to maintain water supply to our customers for smaller asset failure. We have over 840 asset types across water treatment, comprising 18 major WTWs, 14 WTW river intakes, 184 groundwater sources and over 600 distribution booster stations. Amongst all these asset types, there are 50 known assets that are at risk of 1 in 100 or 1 in 1000 fluvial flooding, 1 in 30 pluvial flooding or both. The level of resilience for each asset is assessed based on likelihood and consequence of failure, taking into account the effectiveness of contingency plans and the cost of a resilient solution.

During times of river inundation, maintaining supply to customers is paramount. Whilst fluvial and pluvial flooding incidents may mean smaller sites have to be shut down, our operational contingency plans aim to ensure that water supply to customers is maintained to minimise the risk of unplanned outages. By taking a reactive approach this puts additional pressure on operation resources, and so with climate change forecasting an increase in flood risk this is going to increase pressure on operational effectiveness. Whilst this means we have some operational resilience, this is limited and therefore with the increased impacts of climate change, the likelihood of it being 100% effective is diminishing.

Whilst there is an expectation for water supply climate change resilience schemes to be funded through base allowances, keeping pace with an accelerated climate change should be funded through enhancement. The pressures we are seeing from climate change are not linear, and so not included in base allowances. Whilst we have tried to absorb reactive resilience work to mitigate the impacts of climate change, the step up to provide permanent proactive protection solutions are enhancing resilience beyond base allowances.

## 4.2 Wastewater resilience schemes

We have funded some schemes that provide climate change resilience by working in partnership with other organisations within our base allocation, but whilst we have undertaken similar schemes over recent AMPs we are seeing more co-created resilience opportunities than we can afford within base.

<sup>9</sup> Source: UK Centre for Ecology & Hydrology

As we outlined in Appendix 8 of our Final DWMP<sup>10</sup> (March 2023), we evidenced that we have a strong track record of working with other risk management authorities to co-create integrated solutions which involve the management of pluvial and fluvial flood water. By working together to develop integrated water management solutions, we can reduce the risk of pluvial runoff caused surface water flooding (which is the responsibility of the Lead Local Flood Authority) and sewer flooding (by preventing pluvial run-off from entering the sewers). Similarly, working with the EA has allowed us to develop integrated solutions to improve climate change resilience from river flooding impacting customers' properties, and inundation of the sewerage system contributing to flooding from the sewerage network.

During AMP6, we supported delivery of 26 schemes (compared to a target of 21) with a combined investment of £27m, benefitting 857 properties. For AMP7, we have a specific Collaborative Flood Resilience commitment to support flood risk reduction at 360 properties or areas, in addition to a Green Communities investment of £1.2m of natural capital using the CIRIA B&EST approach. From our ongoing discussions with other risk management authorities, we have a long list of other opportunities to work together to improve climate change resilience to benefit our customers. The additional AMP8 investment opportunities we have identified will unlock significant co-funded opportunities which cannot be funded from base (as evidenced in our DWMP). Taking these opportunities will allow both Severn Trent and delivery partners to provide comprehensive resilience benefits to our customers, resulting in more robust, comprehensive and efficient solutions. We also need to ensure investment is available to align with partners delivery programmes as without funding alignment partnership schemes cannot proceed without all partners agreement.

#### **4.2.1 The 0.7% uplift cannot keep pace with wastewater climate change risk**

There is clear evidence in our DWMP that the impact of climate change is accelerating, and that historic base investment is not sufficient to maintain resilience.

Our DWMP (see Figure 6 below) indicated that £2,126m would need to be invested over a 25-year period to maintain current levels of sewer flooding in a storm by 2050. This compares to the Best Value Plan of £542m that would see the numbers of properties at risk of sewer flooding in a storm increase by 44,000 by 2050. This demonstrates that the level of investment required to maintain flood risk is 400% greater than base allowance.

Whilst the 0.7% climate change resilience uplift is welcomed, and we recognise there are pressures on customers' bills, the Severn Trent allowance of £21.1m for wastewater schemes is significantly lower than that required to address climate change resilience pressures over AMP8.

The four key reasons for this difference are:

1. **Base allowance is already insufficient to maintain climate change resilience.** Our PR09 business plan unit rates were queried by Ofwat because we had designed solutions with a 40-year level of protection, against an industry standard of 30 years. We explained that providing a 40-year protection was equivalent to a 30-year protection with a 7% design storm uplift allowance for climate change. In 2021, new research based on UKCP18<sup>11</sup> (and used in our DWMP) recommended that Severn Trent should be applying a 20% design storm uplift across the region

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<sup>10</sup> <https://www.severntrent.com/content/dam/stw-plc/about-us/drainage-and-wastewater-management-plan/2023/SVE-FDWMP23-Appendix-8-Partnership-Working-and-Scheme-Evidencing.pdf>

<sup>11</sup> [FUTURE DRAINAGE Guidance for applying rainfall uplifts.pdf \(ceda.ac.uk\)](#)

by 2050, meaning our base investment has not been sufficient to maintain climate change resilience since PR09 and so not included in base allowances. As shown in Figure 2 above, past base service funding based on DG5 resolutions has also been focused on cheaper unit cost solutions, with past funding requests for higher cost complex solutions being excluded.

2. **Calculating future resilience needs on historic base allowance is not representative of the likely impacts of climate change.** Evidence from the Met Office, used to inform our DWMP indicates that climate change is not linear, and that basing future resilience needs on historic base allowance is not representative of the future needs. Figure 7 below shows historic global mean temperature differences collated by the Met Office, demonstrating that long-term warming is accelerating (see annotated red line) and, since the 1980s, each decade has been warmer than the previous one. As warmer air is able to hold more moisture, this increases the intensity and frequency of storm events. This is reflected in recent past with the Met Office naming 11 storm over the winter of 2014, supporting why industry research is recommending Severn Trent apply a 20% uplift to design storm rainfall to counter the impacts of climate change.
3. **Flooding risk to customers' properties is increasing due to linked climate factors.** For example, paving over front gardens further accelerates pluvial run-off, and a reduction in permeable area further exacerbates increased climate rainfall. We are also seeing an increase in impermeable area inflow due to highway widening schemes and paving over grass verges to accommodate vehicle parking. The problem with paving over front gardens has been recognised by the Royal Horticultural Society (RHS) in their 2015 Greening Grey Britain Report<sup>12</sup>. This revealed that three times as many front gardens are paved over compared to ten years ago, a total increase of 15 square miles of 'grey', and that plant cover in front gardens has decreased by as much as 15%. They also found that over five million front gardens (one in three) had no plants growing in them, 7.24 million are nearly totally paved over and four and a half million front gardens (one in four) are completely paved over.
4. **Realised risk based on actual incidents is increasing.** Following the retirement of the DG5 Register in 2015, we moved to a risk-based approach aligned to a 2011 UKWIR approach. In Ofwat's PR09 Final Determination, they outlined that funding was only approved for low unit cost schemes, leaving more complex, higher unit cost solutions for companies to address. Despite using our HFRR to prioritise base investment, we have still seen a steady increase due to climate change in the risk scores (see Figure 8 below) despite prioritised scheme delivery removing risk.

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<sup>12</sup> [Why we all need Greening Grey Britain \(rhs.org.uk\)](https://www.rhs.org.uk/greening-grey-britain)

Figure 6: Graph from DWMP (Figure 28, page 65) showing risk of sewer flooding in a storm investment choices

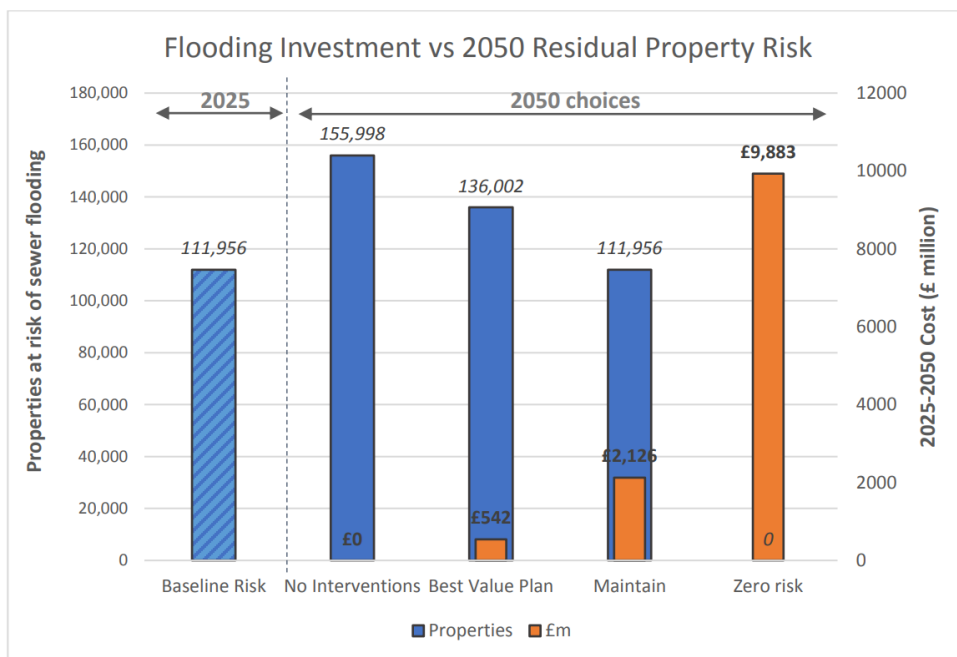
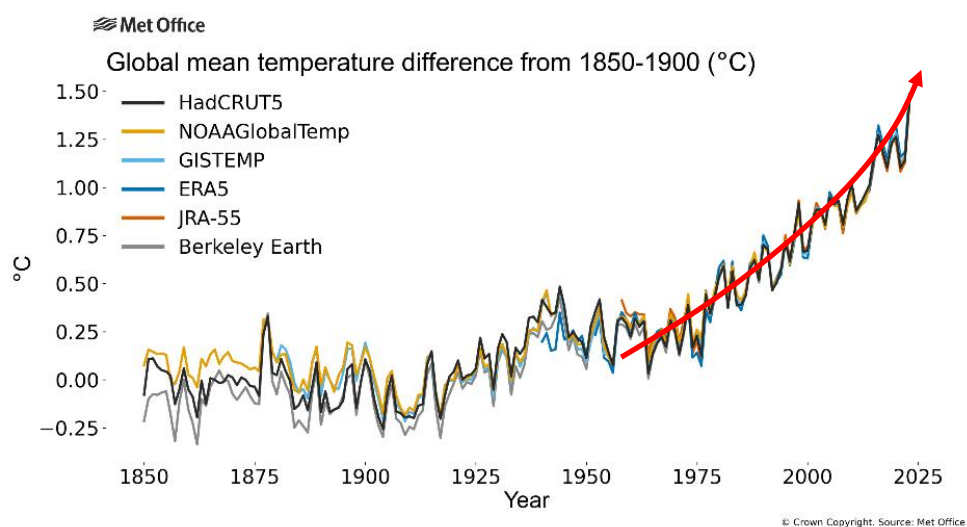
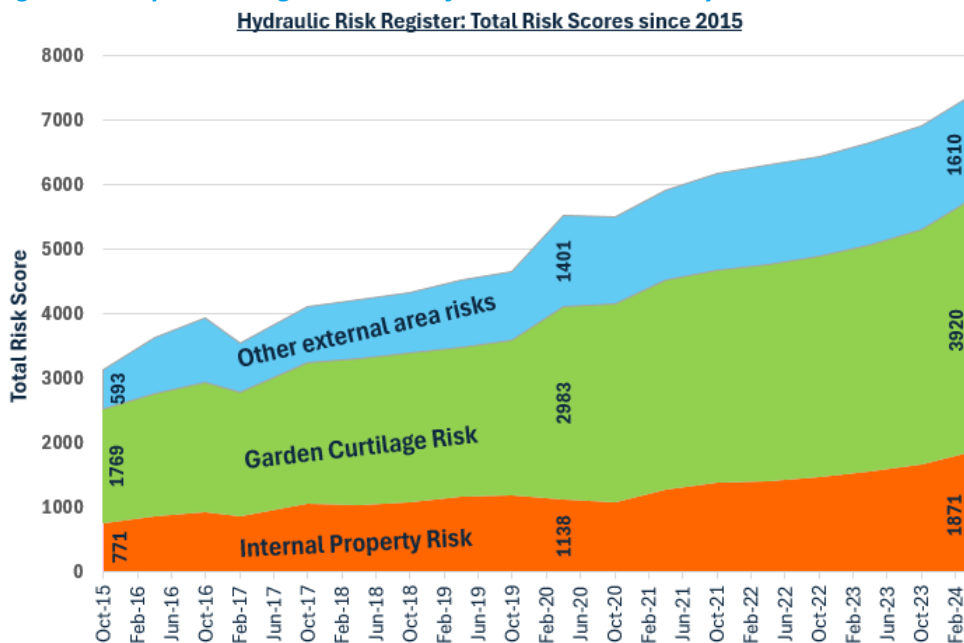


Figure 7: Graph showing global temperature change<sup>13</sup>



<sup>13</sup> Source: Met Office: [2023: The warmest year on record globally - Met Office](#)

**Figure 8: Graph showing increases in flood risk scores on Hydraulic Flood Risk Register**



In summary, the current base allowance is not sufficient to adequately alleviate resilience pressures from climate change, and a single uplift of 0.7% will not be sufficient to maintain current levels of risk of sewer flooding in a storm. This demonstrates that the level of investment needed to maintain sewer flood risk resilience in the face of accelerated hazards goes beyond what could be expected under base.

## 5. Best option for customers

In this section, we provide evidence that we have considered a range of intervention types for both water and wastewater services and have a clear methodology for identifying the most cost beneficial solutions. Where interventions interact with third-party contributors, we have also considered the wider benefits and efficiencies that can be obtained by aligning our respective resilience programmes.

### 5.1 Identifying a range of intervention types

To inform our solutions, we used a variety of strategic components (or combination thereof) to minimise investment whilst maximising resilience benefit. Typically, they include:

- 'Do nothing' (where impact is considered acceptable for a short period of time).
- Manage risks through operational contingency plans.
- Increasing interconnectivity so that service provision is no longer dependent on a single asset.
- Relocation of critical equipment/asset.
- Use of mobile back-up equipment (such as temporary power generators or flow tankering).
- Permanent defences at key asset level.
- Permanent defences at site level.
- Working with other organisations to manage pluvial and fluvial interactions, thereby delivering wider benefits to customers through co-creation delivery efficiencies.

The number of viable options will vary depending on the characteristics of each water and wastewater asset, flood routing and operational needs.

### 5.2 Prioritisation of water resilience schemes

We assessed the resilience of our water infrastructure assets, and the ability of key assets to maintain service during extreme flood events, in line with the 2016 National Flood Resilience Review.

Each site vulnerable to extreme flooding has been appraised against a hierarchy of potential solutions to fit specific service needs, ranging from 'do nothing' through to a relocation of the site or full permanent flood barrier (see bulleted list above).

We used the Environment Agency's fluvial flood risk maps to identify distribution booster stations, boreholes and treatment works expected to be at risk in Flood Zone 3 (High Probability: 1 in 100 annual probability) and Flood Zone 2 (Medium Probability: 1 in 1000 annual probability). These are current baseline risk maps as the Environment Agency do not currently produce future climate change risk maps.

Where an asset is located within a flood risk zone, we mapped asset needs against the 4Rs of resilience (see Table 1 below) to inform intervention needs, including flood protection bunds, protection to chlorine gas facilities, watertight doors and protection to control panels/power.

**Table 1: The 4Rs of resilience, with practical examples**

Mechanism	Scope	Examples
Resistance	Provide protection/prevent damage	<ul style="list-style-type: none"> <li>Construct a flood protection bund around the perimeter of the whole site</li> <li>Excavate channels to drain areas impacted by surface water flooding</li> <li>Intercept pluvial flood paths</li> </ul>
Reliability	Allow the asset to operate within a range of conditions & mitigate damage	<ul style="list-style-type: none"> <li>Install watertight external doors on the building</li> <li>Use of demountable barriers</li> <li>Raise control panels and pumps to above flood level</li> </ul>
Redundancy	Ensure availability of spare capacity and backup installations	<ul style="list-style-type: none"> <li>Provision of an alternative power supply located elsewhere on the site where flooding does not occur</li> </ul>
Response & Recovery	Ensure fast & effective recovery	<ul style="list-style-type: none"> <li>Allow asset/site to fail as impact considered marginal</li> <li>House electrical inside watertight casing</li> <li>Install watertight external doors on the building</li> </ul>

We propose 15 priority water resilience schemes (Appendix A), with a total cost of £19.60 million. Full details are included in Appendix A. We have provided an indicative cost for each site based on initial assessments, but due to the complexity of water sites, more detailed feasibility will be required to ensure an optimal level of resilience. We have also identified a further 15 sites, totalling £4.051m, as reserve sites should efficiencies in delivering priority schemes allow additional enhancements.

### 5.3 Prioritisation of wastewater resilience schemes

#### Asset resilience

We reviewed our sewage pumping station and WwTW sites to identify those vulnerable to 1-in-30-year pluvial flooding and/or 1-in-100-year fluvial flooding, using the Environment Agency flood risk maps with flood depths over 600mm (to take account of typical control panel levels). From this, where an asset was identified as at-risk, we used our asset failure consequence model to determine the number of properties likely to be at risk of flooding should that asset fail.

We have included £0.89m to install mitigation at three assets located within the Environment Agency's pluvial or fluvial flood risk maps (Appendix B). The increased pressure from climate change is increasing the risk on these assets and their inundation, resulting in loss of service. In the event of them being inundated, our asset failure consequence modelling (using asset records, ground levels, OS mapping, property records) indicates there is a risk that around 1,704 customers property could be flooded from the sewerage system. These measures only provide interventions to mitigate the consequence of the hazard, not eliminate the hazard. In prioritising our wastewater resilience, we have also identified a further 12 schemes, totalling £4.5m, as reserve sites should efficiencies in delivering priority schemes allow additional enhancements. We have not included these reserve sites within our wastewater resilience proposal as we have tied to balance asset resilience with opportunities to work in partnership on co-created pluvial/fluvial flood resilience schemes.

#### Partnership pluvial/fluvial flood resilience schemes

We have included £29.33m within a £137.27m partnership programme of ten high-priority partnership resilience schemes (Appendix C). This represents a 79% financial contribution to work with other organisations to co-create integrated long term resilience benefits to 1478 properties, as

well as providing wider (yet to be defined) benefits from nature-based interventions. Whilst the climate resilience uplift fund has included a £21.1m allowance for wastewater, the inclusion of an £9.02m additional funding will generate significant third-party funding which will facilitate the deliver of wider customer resilience benefits. As the 10 schemes we have identified are still subject to detailed feasibility to confirm and evidence the benefit/cost split, we have purposefully not prioritised £21.1m worth of schemes, as costs for each scheme are subject to change. Following completion of scheme level feasibility this will confirm financial contribution splits aligned with their respective benefits, whereby spending £9.02m more is expected to realise £33.2m of third-party contributions to further benefit our respective customers. Not proceeding with these schemes may result in the scheme not progressing or result in additional costs for partners if elements of the solution were phased and so not benefiting from co-creation efficiencies.

We have reviewed the list of partnership schemes we collated for our DWMP to reflect changes in priorities and external funding and recent new opportunities. To do this we have considered:

- Our partners' priorities.
- Severn Trent priorities.
- Our confidence that the proposed interventions will meet the resilience needs of both Severn Trent customer and our partners.
- The maturity of the partnership delivery route.

We have also included a further list of four medium-priority projects, so that if any of the ten high-priority schemes were not able to proceed (e.g. if partners were not able to commit their funding contribution) then we would replace it with a comparable scheme or schemes. Our past experience from our AMP6 Partnership Working ODI and AMP7 Community Flood Resilience ODI has demonstrated the vulnerability of such schemes until all partners are in agreement on scope, responsibilities, scheme design, funding availability and delivery programme, which can result in a scheme being deferred at the last minute. Whilst our prioritisation of our 10 priority schemes has taken account of our partners commitment to each scheme. Should a partner not be able to commit to a scheme due to currently unknown factors outside the control on Severn Trent, thereby delaying a priority scheme progressing (e.g. partners not being able to secure funding), then we would substitute schemes from our reserve scheme list to find a comparable replacement(s) to ensure maximum benefit for customers. Should this result in abortive investment we would look to fund this from base allowances.

## 5.4 LTDS and Customer support

Section 7.1 of our DWMP outlined how we had undertaken customer engagement to inform the development of our DWMP, with specific detail included in 'Appendix 5 – Customer Engagement'<sup>14</sup>. This included research to increase food resilience and climate change, with 71% of customers believing climate change is already having an impact in the UK, and 61% are more concerned about climate change than they were 2 years ago. There was also clear consensus when discussing climate change that investment is needed to avoid the disruption caused by climate change, and that customers want us to keep pace with the growing risk. The environment and climate change featured strongly when asking customers about their priorities for investment going forwards, across

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<sup>14</sup> [SVE-fDWMP23-Appendix-5-Customer-Engagement.pdf \(severntrent.com\)](#)

multiple pieces of research. In our Social barometer survey, the top four future investment priorities are related to these themes:

- Prevent the sewage network from causing environmental pollution.
- Meeting the challenges of climate change and drought, to ensure there is always enough water.
- Ensure the sewer network can cope with external challenges (climate change, population growth).
- Ensure the water pipe network can cope with external challenges (such as ageing assets, natural disasters and customer needs).

As part of our PR24 Long-Term Delivery Strategy we have included investment to ensure we adapt our network to protect our customers from the impacts of climate change. Feedback from our customer research both prior to the PR24 submission and the more targeted customer research post draft determination confirms our customer expect us to invest and prepare for climate change.

In response to the draft determination, we carried out further qualitative and quantitative research with over 1,750 customers. This is set out in full in Section SVE3.01.01 of our representations.

Customers in the qualitative research felt that investing in sustainable drainage is a worthwhile area of investment, recognising the flooding and storm overflow spills issues that the investment will tackle. Green solutions are an intuitive concept for most, and the benefits to the local area are felt to be tangible and visually appealing. When discussing our original investment plan, some raise questions about how the highest risk areas have been determined and question the perceived value for money of the investment in terms of the number of homes protected. However, despite these concerns, customers reiterated their support for our original plan compared to the reduced investment allowed in the DD – the relatively modest bill impact is felt to be worthwhile given the benefits delivered by the investment.

In our representative survey on the DD response plan, investment in reducing the risk of sewer flooding was well supported by customers. 94% of customers rank it as important, and 67% consider it a high priority for investment.

Feedback from customers on the DD response plan overall was extremely positive, with 81% of customers finding it acceptable. The main reasons for the plan being found acceptable are that customers support what Severn Trent is trying to do in the long term and the plan focuses on the right services. When informed about what the plan will deliver, as well as the personalised bill impact, 32% of customers say the future bill is affordable, with a further 37% finding it neither affordable nor unaffordable.

## 6. Cost robustness and efficiency

We have used recent cost estimates to inform intervention costs. For the protection of assets this includes costs to raise control kiosks, provide flood barriers and similar asset level protections as per the 4Rs set out in the table above.

Cost estimates for partnership schemes developed through co-creation of solutions with other risk management authorities use our standard cost curves.

### Data table mapping

The costs associated with this enhancement case are located in the following CWW3 data table line:

**Table 2: Water data table referencing**

Water				
Data table reference	Data table description	Capex total £m	Opex total £m	Totex £m
CW3.118	Resilience	£19.60m		£19.60m
CW3.119	Resilience		£0m	

**Table 3: Wastewater data table referencing**

Wastewater				
Data table reference	Data table description	Capex total £m	Opex total £m	Totex £m
CWW3.168	Resilience	£31.257m		£31.257m
CWW3.169	Resilience		£0m	

## 7. Customer protection

We have developed a Price Control Deliverable (PCD) that sets out the outcomes customers can expect because of this enhancement expenditure. Whilst the activities are split by water and waste, they have a common goal to improve resilience of assets and so as there is commonality in both these outcomes, we have combined them for ease.

Our aim is to ensure customers are protected from under or late delivery through deliverables that are easy to measure, track and verify.

We have taken account of existing regulatory reporting mechanisms and have aligned our deliverables with these mechanisms where appropriate.

We will continue to develop the detailed measurement methodology, which will include third-line assurance review to ensure there is sufficient specificity in the definition to meet the repeatability and reporting accuracy required as part of the APR requirements.

For wastewater, we believe using a measure based on the number of schemes delivered is essential to provide flexibility should a partner not be able to contribute. This mirrors the AMP6 Partnership Working ODI, where flexibility was essential to reflect the uncertainty inherent in partnership schemes that can only proceed if all partners are in final agreement on funding, timing and scope. We will always look to substitute schemes with a comparable replacement. Due to the inherent uncertainty of defining third-party (non-sewer) and sewerage company (sewer) benefits, we do not think using the number of properties affected would be an appropriate alternative. Our experience of partnership working is until joint investigations/feasibility have been completed, there can be variability regarding the numbers of properties, despite a scheme remaining cost beneficial. Consequently, to ensure a common resilience measure across water and wastewater we are proposing number of schemes.

**Table 4: Proposed Price Control Deliverable (PCD)**

PCD	Number of Power and Pluvial/Fluvial Schemes Delivered
<b>Description</b>	Our programme will deliver 28 schemes (15 water and 13 wastewater) to improve the resilience of our assets from power outages and pluvial/fluvial flooding associated with climate change.
<b>Measure</b>	Number of Power and Pluvial/Fluvial Schemes Delivered, to be reported annually.
<b>Conditions on scheme</b>	<p>Schemes will be required to increase resilience against power outages, pluvial/fluvial flooding to mitigate against the impact of climate change.</p> <p>Where a scheme involves partnership funding, delivery of a scheme will be dependent on reaching partnership agreement with a third-party funder as it progresses through the root cause investigation stage, feasibility, optioneering and design.</p> <p>Where a partnership scheme cannot progress, an equivalent substitute will be considered to ensure a comparable benefit to customers.</p>
<b>Assurance</b>	The company will commission an independent, third-party assurer to assure that the above conditions have been met no later than the 31st of March 2030. The separation of these areas will be evidenced through project completion documentation.


**Table 5: Profile of schemes delivered in each financial year**

Deliverable	No. of schemes delivered in FY				
	25/26	26/27	27/28	28/29	29/30
Water Resilience Schemes	2	3	5	4	1
Wastewater Resilience Schemes	2	4	3	4	0

## Appendix A: Prioritised list of water resilience schemes


Priority	Scheme Name	Resilience Driver			Population benefiting	ML/d	Solution Estimate (£m)	'4Rs' resilience intervention focus			
		Pluvial	Fluvial	Power				Resistance	Reliability	Redundancy	Response and Recovery

### Priority Sites

										
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£19.600m | 15 schemes

### Reserve Sites

										
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£4.051m	15 Schemes
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## Appendix B: Prioritised list of asset-specific wastewater resilience schemes



Priority	Scheme Name	Resilience Driver			Consequence of resilience failure (properties at risk of flooding)	Solution Estimate (£m)	Description
		Pluvial	Fluvial	Power			
<b>Priority Sites</b>							
✂							
					£0.887m	3 Schemes	
<b>Reserve Sites</b>							
✂							
					£2.274m	8 Schemes	

### Appendix C: Prioritised list of partnership wastewater resilience schemes


Priority	Scheme Name	Resilience Hazards		Customers benefiting	Resilience Partners	Contributions				Resilience Priority Score	Description
		Pluvial	Fluvial			Severn Trent (£m) post efficiency	Indicative 3rd Party (£m)	Total Cost (£m)	% Contribution		

Priority Schemes

											
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£29.33	£107.94	£137.27	79%	10 schemes	

Reserve Schemes

					
£8.73	£66.09	£74.81	88%	4 schemes	