

Pollution Incident Reduction Plan

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from
**Southern
Water** 

Foreword

Since being appointed CEO in July 2022, I have been clear that our operational and environmental performance has not been good enough. Together with colleagues from across Southern Water, we are committed to achieving real change and deliver the service that our customers and communities deserve. What is more, we have clear plans to deliver a step-change in our performance.

Three years ago, Southern Water was the first business to publish a Pollution Incident Reduction Plan. We are committed to being transparent about the actions we are taking and the progress that we are making. As we move into year four of the plan, we can clearly see how our actions are having an impact - reducing pollutions and strengthening both our understanding of what works, and where to focus our activities next.

This plan gives an overview of the progress made in 2022 and most importantly the lessons learnt, before setting out what we want to achieve between now and 2025. We are all committed to reducing pollutions and improving our environmental performance. It matters to our customers and local communities and it matters to us too.

Setting ourselves challenging targets

By 2025, we want to reduce the number of pollution incidents by a minimum of half compared to 2019, but have plans that could see us go as far as 80%. What's more, we have set ourselves an ambitious target to reduce pollution incidents to zero by 2040.

In 2022 we recorded 358 pollutions. While this is an improvement compared to 2021, we know we need to do much better. And, despite not achieving as much as we wanted to, importantly we do understand why, and we are responding.

The extremes of weather experienced in 2022 were significant. Last year we saw a dry, hot summer, followed by significant rainfall from September to December. The deterioration we saw in our performance was due to a lack of resilience to the extreme wet weather we experienced in the autumn. Everyone is focussed on what we need to do so that we are better able to absorb the impacts of climate change and population growth going forward.

Tackling Storm Overflows – A different approach

Our Pollution Incident Reduction Plan (PIRP) is targeting the upgrades and investments we need to make to our pumping stations and our sewer network to increase operational capacity, efficiency, and resilience.

The PIRP won't address the use of storm overflows because these are part of the legacy Victorian system. To get to the heart of this issue requires a fundamental redesign of our sewer system alongside solutions to reduce and slow the flow of rainwater entering a sewer network that was never designed to cope with the volume of surface water that it now receives.

Alongside the PIRP our Clean Rivers and Seas Task Force is working tirelessly with partners and local communities to identify and demonstrate how separation at source and nature-based solutions have a positive impact. In April we announced a further investment of up to £50 million to accelerate this vital work, and later this summer we'll be sharing a plan that shows exactly what it will take to dramatically reduce the use of storm overflows altogether. This investment is alongside the partnership work that we are doing in the community to create wetlands and reed beds, rain gardens and swales, and use slow-release water butts that our trials have proven dramatically reduce the use of storm overflows. If you want to know more about this work, please see our [website](#).

Looking forward

I know that we have a lot of work to do to deliver the operational performance we need to reduce pollutions. While I am pleased with the progress we have made, now is the time to step up a gear. The analysis in this document, together with the plans that we have in the coming months and years demonstrate that we not only have a clear understanding of what needs to be done, but also what we need to prioritise to create meaningful and sustained change. As Southern Water’s Chief Executive Officer, I am dedicated to delivering the reduction in pollutions that our customers and communities deserve and to improve the quality of our environment and rivers and seas that we all value so highly.

Stay safe,

Lawrence Gosden
Chief Executive Officer

June 2023

How we prepared this report

In preparing our plan, we carried out an analysis of the root causes of pollutions over 2022. This has shown that out of 358 Category 1-3 pollutions in 2022, the top root causes of pollutions were:

- 31% - Blockages from Fats Oils & Grease (FOG) & Unflushables
- 25% - Electrical faults at Waste Treatment Works and Waste Pumping Stations
- 10% - Burst rising mains
- 8% - Third party failures
- 8% - Control issues
- 6% - Mechanical faults

This analysis has informed our 2023 Pollution Incident Reduction Plan (PIRP). The PIRP is focussed into three workstreams: Asset Resilience, Escape Prevention and 3 Lines of Defence and contains 18 separate initiatives. This plan will deliver a pollution benefit reduction range of between 126 – 212 pollutions through incident prevention, proactive interventions, and fast pollution response and asset recovery.

The 2023 plan is based on multiple lessons learnt from 2022, enabling us to re-prioritise and focus on the actions that we know really make a difference in a more agile way.

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Executive Summary

This report analyses our performance, assesses how our efforts to improve are being impacted and looks at where we plan to focus our attention in year four of the plan.

As we move into its fourth year, we can see how the plan is reducing pollutions and helping us understand the best methods to adopt and where to focus our activities. This plan gives an overview of the progress made in 2022 and the lessons learnt, before looking at the way ahead until 2025, to continue to drive down pollutions towards our targets.

Review of 2022 pollutions performance

Pollutions are categorised by the Environment Agency based on their impact on the environment. For the purposes of the Environment Agency's Environmental Performance Assessment (EPA), only Categories 1 to 3 are included as category 4 is deemed to have 'No impact'. The data is measured on a calendar year basis. Our results for 2022 are shown in Table 1.

Table 1 – Performance summary by category

Pollution category	2019	2020	2021	2022
Category 1: Major damage to environment, people and/or property	3	0	3	2
Category 2: Significant damage to environment, people and/or property	4	4	9	3
Category 3: Minor damage to environment, people and/or property	423	398	360	353
% Self-reported	87%	88%	90%	90%
TOTAL	430	400	372	358

Improvements were made across several key areas in 2022, however when we analyse our past performance, our performance was affected by supply chain issues and contractor resource constraints, and the machine learning phase of network digitalisation taking longer than originally anticipated. These key areas had an impact on delivery of some parts of our 2022 plan, in particular the expected improvements to our wastewater pumping stations and sewer network, accounting for 103 pollutions.

The extremes of weather experienced in 2022 also had an impact on our performance. Last year, there was a dry, hot summer, followed by significant rainfall from September to December. These extremes of weather added around 83 pollutions to our numbers, with category 1 to 3 pollutions from Rising Mains (RM), Foul Sewers and Combined Storm Overflows (CSOs) as well as Wastewater Treatment Works (WTW) showing a significant deterioration in the final quarter of 2022, due to a lack of resilience in extreme wet weather.

Analysing the root causes for pollutions

When we developed our 2023 plan, we carried out an analysis of the root causes of pollutions during 2022. This analysis showed that out of the total number of 358 category 3 pollutions in 2022, the top root causes of pollutions (shown in percentages) were blockages from fat, oil and grease (FOG) and unflushable items (31%), electrical faults at WTWs and WPSs (25%), burst rising mains (10%), third party failures (8%), control issues (8%) and mechanical faults 6%.

This root cause analysis has informed the development of the plan for year four, leading us to divide our 2023 PIRP strategy into three key workstreams, these are asset resilience, escape prevention and three lines of defence. The three lines of defence cover interventions to reduce pollutions via incident prevention, proactive interventions, and pollution response and asset recovery. The plan aims to deliver a pollution benefit reduction range of between 126–212 pollutions.

The 2023 plan

Our 2023 plan provides a comprehensive overview of our 2022 pollution performance and an in-depth analysis of root causes for the performance described. It also looks ahead to year four of the plan’s delivery, showing the actions scheduled for a continued reduction in pollutions.

The 2023 plan is based on lessons learnt from 2022, enabling us to reprioritise the most impactful initiatives with the focus on a more agile delivery approach and we have incorporated what we have learnt into our 2023 plan.

One of the highlights of our plan is the digitalisation of our wastewater network, installing 23,000 sewer level monitors (SLMs) by December 2022. The implementation process requires three months of machine learning before the full benefit of pollution reduction can be realised.

1. Pollution Performance Summary & Trends

Category 1 to 3 pollutions from 2019 to 2022

In 2022 we recorded 358 category 1 to 3 pollutions; this is a 4% improvement on the number of pollutions in 2021. Figure 1 shows the steady decrease in the number of pollutions year on year from 2019, although this reduction has not been at the pace we would like to see.

As part of our turnaround plan, we are targeting a sustained yearly reduction in category 1-3 pollutions shown in figure 1 below, enabling a three-star rating under the EA’s Environmental Performance Assessment. We keep these targets under review.

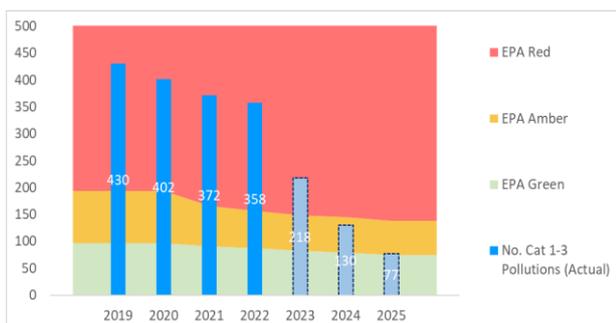


Figure 1 2019 to 2022 Total Cat 1 to 3 pollutions

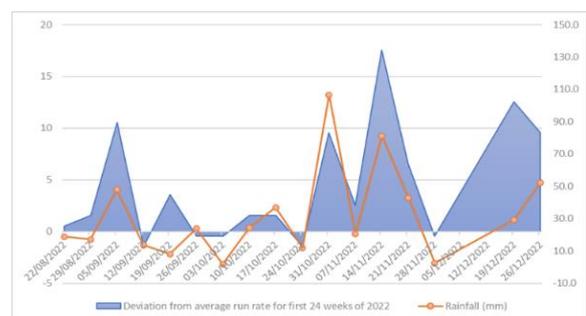


Figure 2 Deviation from average Pollution run rate and correlation with rainfall

Our analysis of pollution performance in 2022 shows that a deterioration in performance in the second half of the year is driven by distinct weeks.



Figure 2 shows the pollution peaks in weeks 36, 44 to 47, and the rainfall volumes which fell in those weeks. There was significantly higher rainfall, with a peak of 245 mm, compared to a Long-Term Average (LTA) of 96 mm of rain in the first week of November, which was 255% of the LTA. Our analysis shows 86 weather related pollutions during the period shown.

During the July and August heat wave, where average temperatures were 1.5 to 1.8 degrees higher than the 30-year average, there were more incidents than average, with the highest proportion (34%) of category 3 incidents taking place in July, when compared to the previous two years. The difference compared to the average for 2022 was 23% and for July in 2021 was 11.2%. This is an indicator of the increased environmental impact of releases due to strong crude and reduced dilution, as watercourse levels were low. Reduced flow through the network also resulted in an increase of foul sewer pollutions caused by blockages.

The lessons learned from this has informed the interventions in the 2023 PIRP which contains plans to tackle the impacts of extreme weather typical of climate change using what we learned from Storm Eunice, as well as the summer heat wave/low flow conditions, and the autumn and winter storms. We acknowledge that extreme weather events associated with climate change are here to stay and we have adapted our plans to improve resilience to extreme weather events.

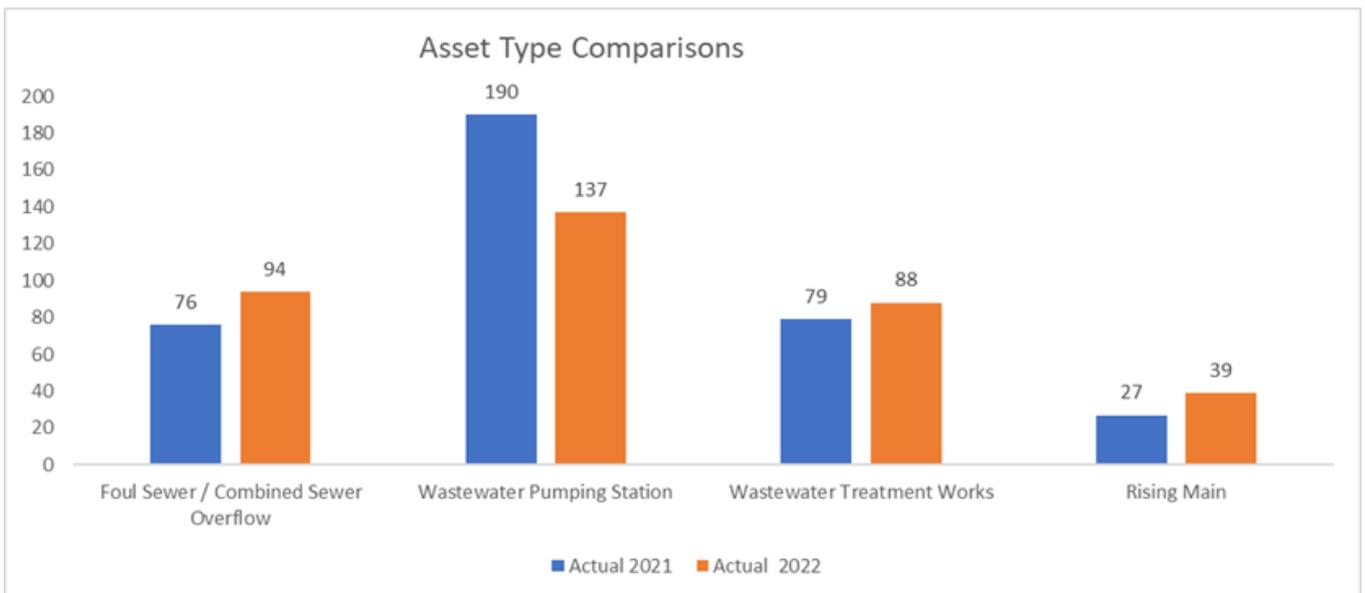


Figure 3 2021 to 2022 Comparison of Pollution from different asset types

Figure 3 shows pollutions from pumping stations (WPS) improved by 28% due to a £37.5m capital maintenance investment into areas such as pumps, valves, and control systems. This led to increased resilience in our asset base, as asset availability increased by around 8%. The improvement in this area continues in 2023.

However, category 1 to 3 pollutions from rising mains (RM), foul sewers/CSOs (Combined Storm Overflows) and wastewater treatment works did not improve, with a significant deterioration seen in the final quarter of 2022. The lack of resilience in these areas can be seen particularly during extreme wet weather. Blockages on the sewer network also increased over the extended dry period, culminating in releases with more impact on the environment over the summer period.

Serious pollutions 2019 to 2022

In 2022 we recorded two category 1 and three category 2 pollutions, representing a 58% improvement on the number of pollutions in 2021 (figure 4). This falls slightly short of the ambitious 60% target we set ourselves in our PIRP 2021 plan. Under the Environmental Performance Assessment (EPA), this will be given a red status in the RAG (red, amber, green) ranking, and we are doing everything we can to achieve green status going forward. Our ambition is to challenge ourselves further and focus on serious pollutions to meet our target forecast of reducing the number of serious pollutions to one by 2025.

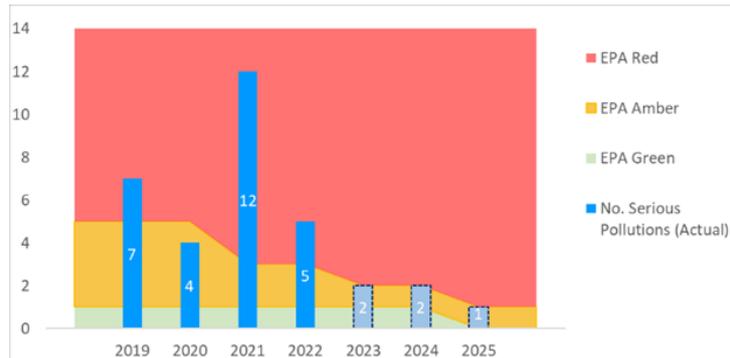


Figure 4 Actual & Forecast Serious Pollutions 2019 to 2025

Serious pollutions in 2022 dropped by over half, from a total of 12 in 2021 to five in 2022. We believe this is a significant improvement and a notable move in the right direction. At wastewater pumping stations, we reduced incidents from six in 2021 to just one incident in 2022.

Clean water pollutions 2019 to 2022

In 2022 we recorded 32 clean water incidents associated with the water distribution network and water supply works. An increase year on year for this type of incident has been seen since 2020 and improvement plans are underway to turn the trend around and make reductions.

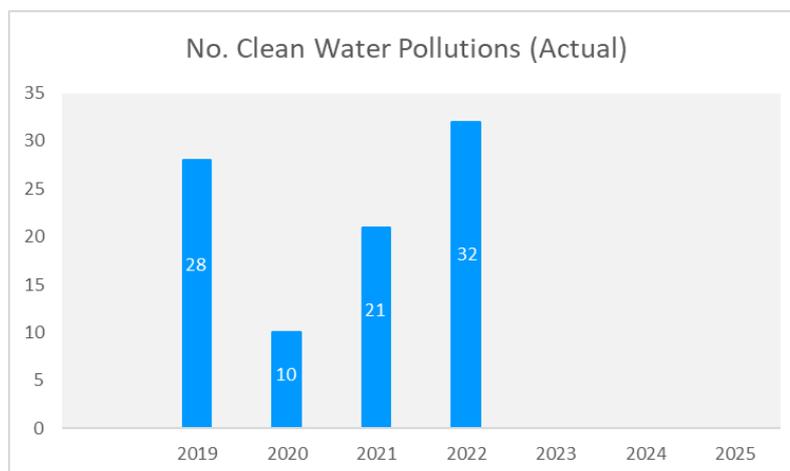


Figure 5 Actual & Forecast Clean Water Pollutions 2019 to 2025

2. Root Cause Analysis

2022 Category 1 to 3 pollutions root cause

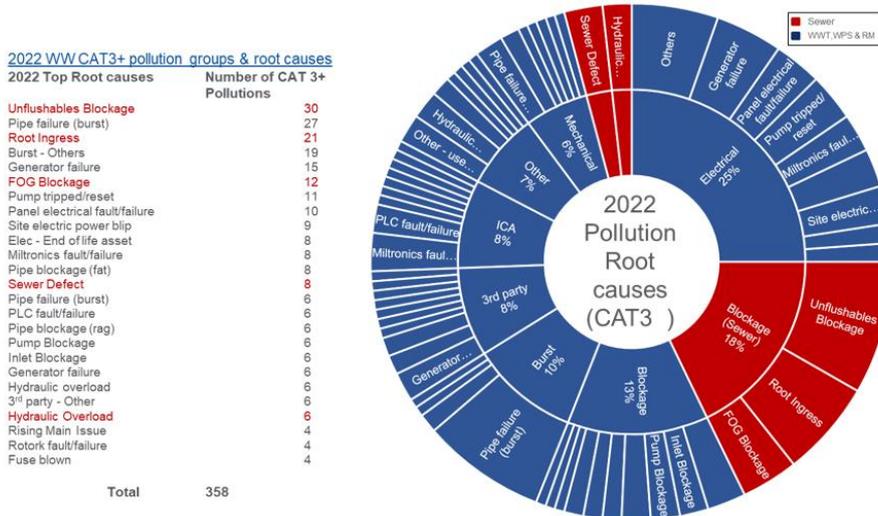


Figure 6 Detailed Root Cause Analysis of Cat 1 to 3 pollutions in 2022

Figure 6 displays a summary of the detailed analysis of the root causes of pollutions in 2022. This shows the top root causes of pollutions were blockages from FOG and unflushable items (31%), electrical faults at WTWs and WPSs (25%), burst rising mains (10%), third party failures (8%), control issues (8%) and mechanical faults 6%.

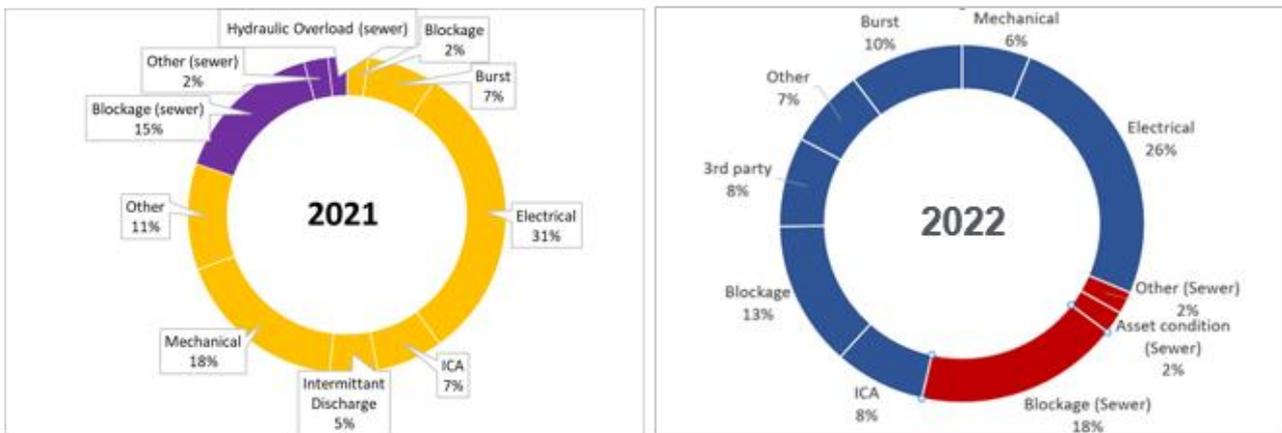


Figure 7 Comparison of Root Causes between 2021 and 2022

In the early part of 2022, in partnership with IBM, significant work as part of the 2022 PIRP was completed to improve an analysis of the root causes, together with considerable upskilling of the investigation teams. This has enabled a more detailed understanding of asset failures. The comparison of 2021 and 2022 shown in figure 7 demonstrates that when compared to 2022, the Mechanical Electrical Instrumentation Control & Automation (MEICA) root cause fell as a proportion, with an increase, particularly in blockages. Clear benefits can be seen in the (MEICA) root causes - which are all lower year-on-year - particularly in the Electrical and Mechanical classes showing the improvements made.

2022 Serious pollution root cause

We have improved our processes of understanding root causes and capturing the data. The pollution response team follow the 30-minute pollution plan and standard operating procedures when a pollution incident has been reported. Following this, a detailed site visit is carried out and a bow tie analysis completed. A Director review is held on every serious pollution to ensure full understanding of root cause and delivery of regional tactical initiatives.

Site Name	Pollution Category		Asset Group	Root cause
Palace House, Bishops Lane, Bishops Waltham, Southampton	Cat 1	05/07/2022	Foul sewer	Blockage – FOG, rag, manhole cover
Wellbrook Farm, Berkeley, Mayfield, East Sussex	Cat 1	18/07/2022	Foul sewer	Blockage – corrosion, non-flushables
Galley Hill Bexhill WPS	Cat 2	17/08/2022	WPS	Storm pump failure
Coldharbour WTW	Cat 2	13/09/2022	WTW	Mechanical asset fault
Jefferstone Lane St Mary's Bay	Cat 2	14/11/2022	Rising main	Rising main deterioration

Table 2 2022 Serious pollutions

2022 Clean water root cause

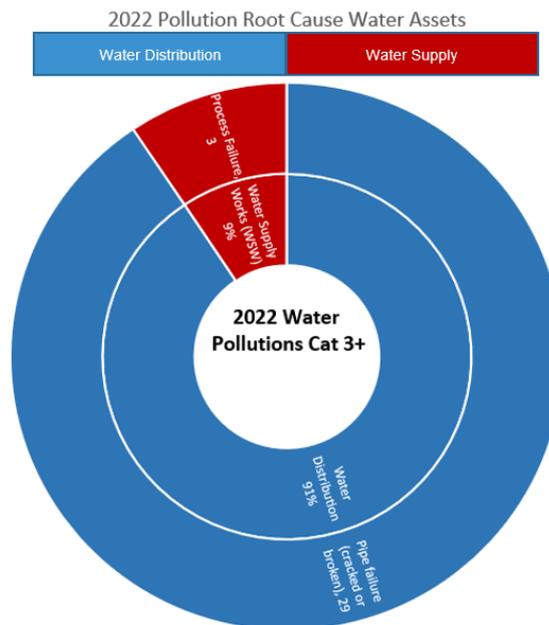


Figure 8 Clean Water Pollution Root Cause

Figure 8 shows most clean water pollutions come from the water network, with the majority – a total of 29 pollutions – due to cracked or broken pipes in 2022. There were three category 3 pollutions from Water Supply Works (WSWs), due to process failures.

3. Effectiveness of Previous Interventions

Total category 1 to 3 pollutions

The effectiveness of previous interventions can be seen in table 3. The positive numbers show the benefits associated with 2022 interventions and flow through from the 2021 PIRP initiatives. The negative numbers show the impacts of weather, supply chain issues and contractor resource constraints as well as the impacts of the longer machine learning phase of network digitalisation.

Initiative	Premise	Pollution No.s	Comments
Weather Impact	WPS	-25	Adverse rainfall related
WPS Upgrade to Platinum Std	WPS	-43	Significant re-design required to bring to innovative platinum standard. Delays associated with supply chain and contractor resources
WPS Proactive Control	WPS	59	Good benefit realisation for the proactive alerting from the WPS risk viewer (PSRV) above expectations
Auto Pump Resets	WPS	25	Flow through from 2021 PIRP
Wet Well Cleaning	WPS	7	Good benefit realisation above expectations
Capital Maintenance	WPS	30	Increase spend on pumps & associated parts
Totals		53	
Weather Impact	FS/CSO	-26	Unable to sustain 2021 runrate due to drought conditions
Network Digitalisation	FS/CSO	-23	High proportion of inactive SLMs pending machine learning
Network Cleaning / Jetting	FS/CSO	25	Cleaned 700km sewer
Totals		-24	
Weather Impact	RM	-21	Unable to sustain 2021 runrate due to drought conditions & impact of wet weather in latter part of the year
Rising Main Calming	RM	7	50% Plan completion over 4 year programme
Totals		-14	
Weather Impact	WTW	-14	Adverse rainfall related
Inlet works	WTW	-17	Programme deferred due to contractor / supply chain constraints
Inlet wet well cleaning	WTW	-17	Programme phasing adjusted to ensure completed over dry months. Now in progress
Drainage Plans	WTW	-3	Site surveys showed no pollution reduction benefits. resource diverted to more impactful projects associated with pollution reduction
Totals		-51	

Table 3 Effectiveness of Previous Interventions in 2022

Despite substantial progress with the majority of the 2022 PIRP, the delivery of benefits was slower than planned due to two key challenges:

1. A full understanding of the time it would take for the machine learning of our industry leading Artificial Intelligence (AI) technology to be completed, enabled by the installation of 23,000 Sewer Level Monitors (SLMs).
2. Supply chain issues with parts and contractor labour shortages impacted on the time to implement remedial works on some of our most polluting pumping stations.

Pollution performance was also impacted by extreme weather conditions, particularly rainfall at two and a half times the average amount (255% LTA), with 245 mm of rain compared to the 96 mm average in the first week of November 2022. This meant that we did not manage to reduce as many pollutions as we had hoped.

Analysis has shown that the 2022 PIRP work completed to date provides a solid platform for improved performance in 2023. Improvements made to understanding root cause have built confidence that the plans

are sufficiently focussed in the areas of highest impact. The year 4 PIRP has also been realigned to the 2023 calendar year which reduced year 3 to a 9-month plan.

Task Name	Project Description	Cat 3 decrease	RAG Status
STRATEGIC PROJECTS	Control Centre Transformation	29	Amber
STRATEGIC PROJECTS	Waste network Digitalisation	36	Red
STRATEGIC PROJECTS	Proactive Maintenance	2	Green
WPS UPGRADES	Platinum health checks & Remedials	63	Red
WPS UPGRADES	WPS Internal Reset removal	3	Green
INCREASE WPS/WTW ASSET AVAILABILITY	Black starts WPS	12	Green
INCREASE WPS/WTW ASSET AVAILABILITY	Inlet Well Cleaning Programme	17	Amber
INCREASE WPS/WTW ASSET AVAILABILITY	WTW Inlet works project	17	Amber
INCREASE WPS/WTW ASSET AVAILABILITY	Drainage Plans & Remedials	3	Amber
WPS & NETWORK CAPACITY / ESCAPE PREVENTION	Wet Well Cleaning Programme	5	Green
WPS & NETWORK CAPACITY / ESCAPE PREVENTION	Sewer Network Cleaning Programme	5	Green
WPS & NETWORK CAPACITY / ESCAPE PREVENTION	CSO Care Plans	10	Green
WPS & NETWORK CAPACITY / ESCAPE PREVENTION	High Risk Manhole Inspections	6	Green
WPS & NETWORK CAPACITY / ESCAPE PREVENTION	Sewer Network Capacity Surveys	5	Green
WPS & NETWORK CAPACITY / ESCAPE PREVENTION	Dual Sewer Surveys & Capping	5	Green
WPS & NETWORK CAPACITY / ESCAPE PREVENTION	Sewer Ingress Surveys & Remedials	4	Green
WPS & NETWORK CAPACITY / ESCAPE PREVENTION	Rising Main Calming Plans	14	Green
WPS & WTW SPILL REDUCTION	Network Whole Permit Compliance	2	Green
WPS & WTW SPILL REDUCTION	IOW Focus	3	Green

Table 4 2022 PIRP Delivery RAG status

The end of year programme review, summarised in table 4, shows two key projects where benefits delivery remained at red status at the end of the year, one at amber, and three projects under review with the remaining projects all at green status. Green status indicates a programme is on track with project milestones and KPIs, amber indicates some slippage to timeline but recoverable and red indicates slippage to timeline resulting in delays to benefits realisation.

Waste Network Digitalisation and the Control Centre

The scope and the extent of innovation associated with this industry leading programme to digitalise the wastewater network, meant that the expected benefits were not realised in 2022. Although 23,000 sewer level monitors were installed by December 2022, around 60% of these were pending activation before a three-month machine learning exercise could take place. This exercise was necessary to realise the full benefit of pollution reduction. Southern Water is industry leading with less than 5% No Fault Found (NFF) on proactive site visits. This is a good measure of the accuracy of machine learning and the associated targeting of resources we can deploy out in the field. The benefits associated with the proactive control centre are intrinsically linked to network digitalisation, with machine learning being the key dependency. The expected benefits from network digitalisation and the proactive control centre have been phased into the 2023 pollution forecast.

Platinum Health Checks (PHC) and Remedials

We selected 280 wastewater pumping stations for Platinum Health Checks (PHCs). These wastewater pumping stations were selected based on sites with a repeat pollution in the last three years, prioritised by their impact on the environment. All 280 surveys were completed on the top polluting sites, however remedials were delayed due to supply chain issues and contractor delivery. The extent of remedial work has

also been far greater than initially estimated. The remedials for the top 52 wastewater pumping station sites are now well underway in 2023.

To make sure progress is made faster, this initiative has been adapted for 2023, using a sprint style programme called Wastewater Pumping Station Resilience. The programme includes the use of in-house M&E (mechanical and electrical) expertise. This programme focuses on the next top 60 risk sites.

The wastewater pumping station Black Start programme

Our Black Start programme increases our ability to recover after a blackout and restart the pumps. The WPS black start programme is complete and as with the 2021 WTW Black start programme, now forms part of daily maintenance activities – our business as usual. Storm Eunice tested how well the Black Start programme worked, with no serious pollutions or discharge from the larger wastewater treatment works or terminal wastewater pumping stations. As an example, during the storm, Budds Farm wastewater treatment works restarted twice, and East Worthing wastewater treatment works restarted five times.

Wastewater treatment works Wet Well Cleaning programme

The wastewater cleaning programme wet well cleaning programme was inappropriately scheduled for the final quarter of 2022 and was unable to be completed due to wet weather seen at the tail end of 2022. This has now been scheduled for the dryer months of 2023 and is in progress as business-as-usual.

Wastewater treatment works Inlet Works programme

The scope of the wastewater treatment works Inlet Works programme is currently under review and the revised scope will be included on an ongoing basis. The programme was found to have less impact than other initiatives for pollution reduction, highlighted by an evaluation done through a deeper dive and pareto analyses. Improvement activities have been identified, and these are being incorporated into the non-compliant spill reduction business-as-usual activities.

Drainage plans

The Drainage plan project was reviewed, after initial surveys showed limited pollution reduction benefits. It was therefore de-prioritised.

Sewer Network Cleaning programme

This programme was successfully completed with 700km of sewers being cleaned. The results outperformed the expected benefits. This is now part of everyday work and as the network digitalisation programme matures to be fully implemented, it will be optimised to provide condition-based maintenance. In depth analyses and work continues in this area.

The remaining programmes include dual sewer surveys, sewer ingress and remedials, planned preventative maintenance, wastewater pumping station internal reset, CSO care plans, high risk manhole (HRMH) inspections, network whole permit compliance and a focus on the Isle of Wight. All these programmes are on track.

Serious Pollutions

The initiatives outlined in table 2 (Effectiveness of Previous Interventions in 2022), will be effective for all types of pollutions. However, we are aware that serious pollutions demand a particular effort to consistently focus on proactively stopping the incidents that have a substantial impact on the environment. To strengthen the environmental impact assessment, we have divided our key improvement activities into three areas, these are people, processes and systems. These areas will be focussed on process rigour and clear accountability for capturing evidence, with a suite of new tools being used to increase effectiveness.

People:

- The 30-minute pollution plan – continuous reinforcement through wastewater wide stand-down briefings.
- Continued development and embedding of the Pollution Control Lead role and responsibilities within the Operational Control centre, providing ownership and accountability.

Processes:

- Using the expertise of Adler & Allen to provide background environmental profiles of high-risk areas, improving our ability to capture evidence, and put in place remediation processes.
- The 30-minute pollution plan – introduction of 1st and 2nd line assurance to the 30-minute pollution plan, to embed rigorous adherence, root cause identification and resolution, and repeat themes.
- Seasonal readiness processes with incident management improvements.

Systems:

- Refinement of the available network digitalisation to address emerging risk areas.
- Additional signals, technology such as cameras, and further integration into machine learning platforms to improve early detection and avoidance.
- Rollout of the pollution response app through our wastewater operations and our supply chain, and delivery of second phase improvements by providing transparency and visibility to our supply chain and sharing lessons learnt.

Focusing on rising mains

An analysis of rising main performance has showed the success of focusing on repeating sites for the calming programme, with a 75% reduction in repeat Category 3 rising main incidents from 2019 to 2022.

Multiple incidents occurred across 24 sites between 2019 and 2021, with one location repeating five times (Lower Road Lower Halstow WPS), and one location repeating four times (Pollards Moor Cadnam WPS). Calming measures were installed at Lower Road Lower Halstow WPS in 2021, and there have been no incidents since then. Pollards Moor Cadnam WPS, with four repeat incidents, has 500m of lining work planned with overland mitigation options being prepared.

Three out of the last four years have seen a greater percentage of rising main incidents occurring in the second half of the year. It is likely that these are linked to increases in hydraulic flows and therefore greater periods of time at higher hydraulic pressures. The addition of pressure monitoring to our existing rising main calming programme will help to address this.

Focusing on resilience to extreme weather events

Storm readiness improvements have been made within the Control centre utilising intelligence from predictive alerts and existing alarms. Systems and processes have been strengthened, with forecasting of extreme weather now triggering the use of readiness plans across all regions. In addition, specific seasonal readiness plans are driven via weekly check-ins with Director sponsorship.

Weather readiness activities were developed in the last quarter of 2022. These are specifically to address the risk associated with rolling power blackouts, while informing incident planning and improving response. They use effective risk visualisation (figure 14), prioritisation, and collaborative coordination with our supply chain.

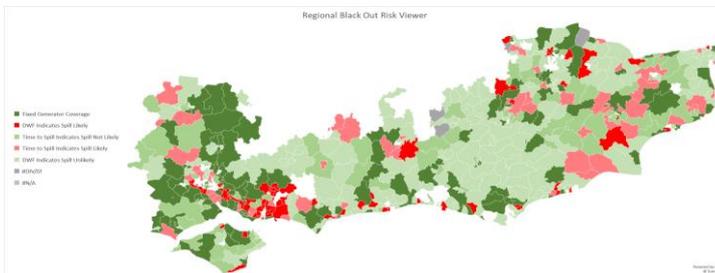


Figure 9 Regional Blackout Risk Viewer



Figure 10 Risk of spill

Other activities to address the risk of rolling blackouts included:

- Close cooperation and liaison between Southern Water, SSE and UKPN for planning and blackout notifications.
- Creation of a risk visualisation model (figures 9 and 10) to identify wastewater sites which are at risk of spilling during a given blackout event, enabling more robust incident and resource planning:
 - The model is based on asset availability, with calculated time to spill and theoretical dry weather flows.
 - Greater risk visibility and incident response is possible through geographic mapping and the evaluation of environmental impact.
- Engagement with the supply chain increasing the in-house mobile generation resources and providing greater site coverage.
- Creation of a blackout cross functional team to assist planning and coordination between Operations and supply chain.

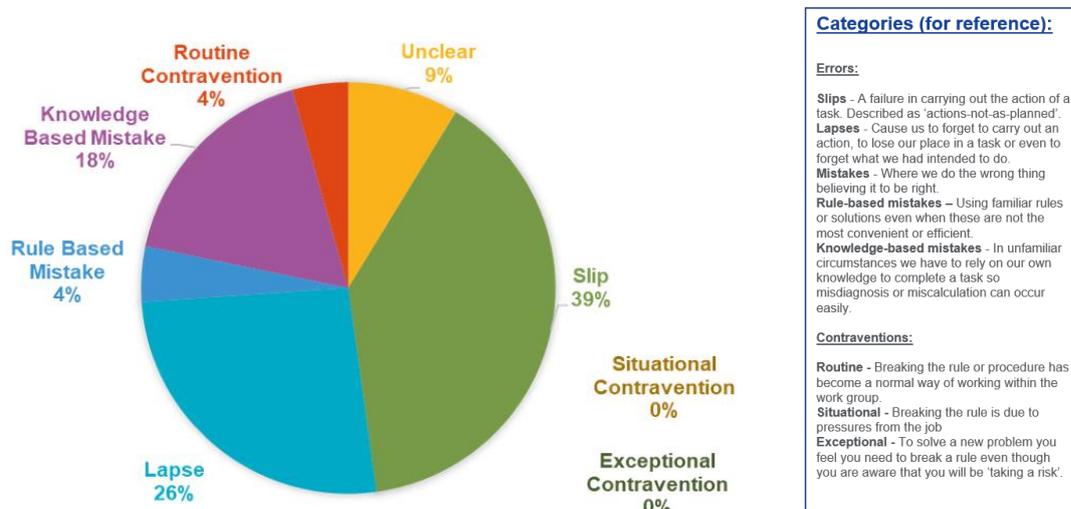
Focusing on human factors

We created a new Human Factors Practitioner role to increase our human factors investigation capability.

The investigations help not only to identify errors but also to use this knowledge to optimise best practice and limit future risk of repeat incidents. Investigation in this instance is not to attribute blame but to empower staff, improve processes and learning, and to have a positive effect on performance.

Figure 11 shows what we have found so far with 111 recommendations made to date, including 66 practical immediate interventions and 45 future interventions.

Figure 11 Human factor root cause



Findings are reported to the business in a bulletin, as well as via direct cascade and discussions in monthly wastewater management meetings. Learnings specific to individuals are fed back to the line manager for discussion.

An incident learning cycle has also been developed. The cycle uses qualitative findings relating to training and knowledge-based mistakes, by feeding them into the Operator Training programme, effectively creating a corrective learning loop.

Case studies

Pumping Station Risk Viewer Response (PSRV)

We have been working to improve our Pumping Station Risk Viewer Response (PSRV), making it less likely for pollutions to be caused from pumps not working properly or breaking down. Using PSRV creates alerts signalling a pump issue, so we can quickly respond by putting it right. At the end of 2022, 46% of our wastewater pumping stations were covered by PSRV, resulting in a reduction of 59 pollutions. Coverage to the end of April 2023 was 60%, with plans to reach full coverage by the end of March 2024.

Case Study 1 – PSRV, Blowers Hill, Speldhurst WPS [figure 12]

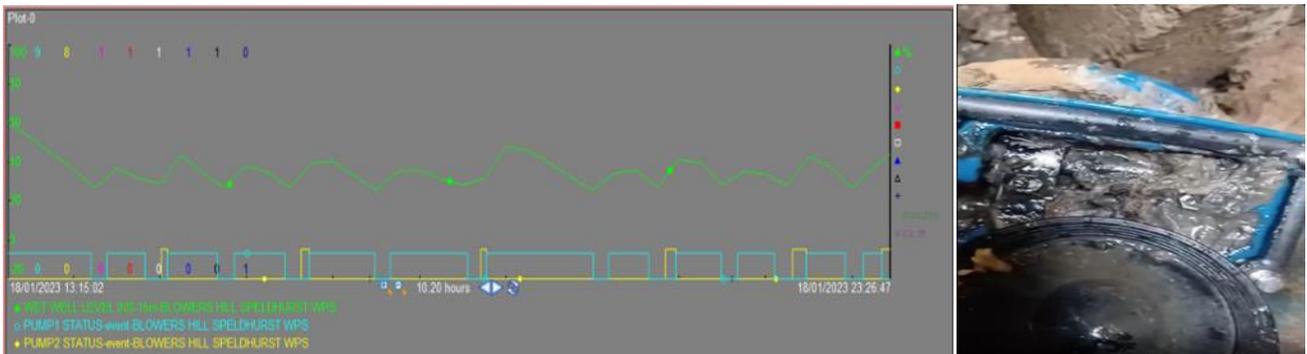


Figure 12 PSRV trends showing Pump 2 anomalies & worn pump.

In January 2023, a PSRV exception alert was received about the pumps at Blowers Hill Speldhurst wastewater pumping station (WPS). The alert showed that pump 2 needed assistance from pump 1 on every run, indicating problems with pump 2.

We responded to the alert by checking the pump, revealing rag in the NRV of pump 2. The check identified that the pump was positioned incorrectly and had worn bearings and impellers. The pump was therefore replaced, reducing the risk of it going wrong in the future.

Case Study 2 – PSRV, Colts Hill WPS [figure 13]

At Colts Hill wastewater pumping station, a PSRV alert was received in May 2023 showing that pump 1 needed assistance on every pump cycle. When we went to check it, we found that pump 1 and the non-return valve (NRV) were blocked and worn. The blockage was cleared, and new pumps were installed bringing the pump back to normal running.

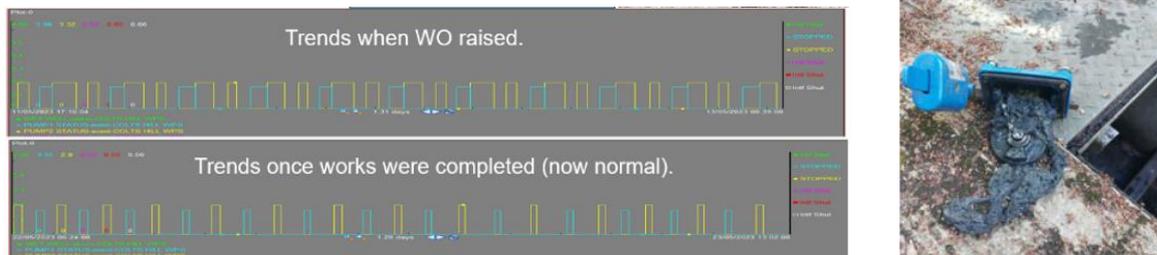


Figure 13 PSRV trends showing Pump 1 anomalies & evidence of RAG blockage

Platinum Health Checks & Remedials

Case Study 3 – Tates Copse WPS (figure 14)

Our Platinum Health Checks are a useful way to identify potential issues with equipment on sites. We put in place a Platinum Health Check at Tates Copse wastewater pumping station, as the pollution root cause analysis for this site had shown failures with the instrumentational control and automation (ICA) panel and pump failures. The site was set up using three shaft driven DWF pumps running in a duty assist standby arrangement. The repair and servicing cost of shaft driven pumps and motors are higher than submersible pumps, and there is a lack of availability of spare parts.



Figure 14 WPS PHC & Remedials - Before and After New Pump & Electrical Upstand Installation

We took action to carry out works to install three new dry well submersible pumps, along with putting in place new and more efficient soft starts, and installing new pipework, non-return valves and auto resets. A redesign of the manifold and access was also needed. Once installation was complete, the inlet and outlet valves onsite were rattled and serviced to ensure operation, allowing for safe maintenance in the future.

Next, electrical upstands were created for pump cable termination and safe isolation points were installed, due to space constraints within the control panel. New Floor plates were also installed to cover the previous location of electric motors and new internal and external LED lighting was put on the building, to make sure the area is a safe working environment at all times of the day and night.

The work carried out has been a success, with no further pollutions at this previously repeating site.

Sewer Level Monitors and Digitalisation of the Sewer Network

Case Study 4 - Ash Close.

When an alert was received from a sewer level monitor on a housing estate, we went to investigate.

The digitalisation of the sewer network means proactive alerts can be received by the proactive control centre, whenever levels in the sewers are higher than expected (figure 15).

Our team went out on the day of the alert and discovered blockages causing the higher-than-expected sewer levels. It took several tanks of water to clear the blockages and the sewer was left free flowing (figure 16). Follow up work was done by our FOG and Unflushables team, making customer visits to talk about how to avoid blockages, as well as using CCTV cameras to survey the sewers.

This case study shows the benefits that we get from digitalisation of the sewer network, with alerts being received by the proactive control centre, whenever levels in the sewers are higher than expected (figure 15).

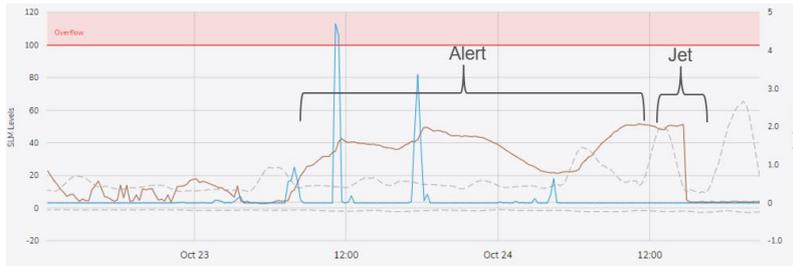


Figure 15 Storm Harvester platform - trend and alert period



Figure 16 Surcharged manhole prior, during and after jetting

4. Pollution Incident Reduction Plan

Planned interventions and expected impact – category 1-3 pollutions

In this fourth year of the PIRP strategy, we have used the root cause analysis of 2022 to focus our 2023 improvement plans.

We estimate that the plan will reduce the number of pollutions by 126–212 incidents. This is being achieved using incident prevention and proactive interventions, as well as fast pollution response and asset recovery.

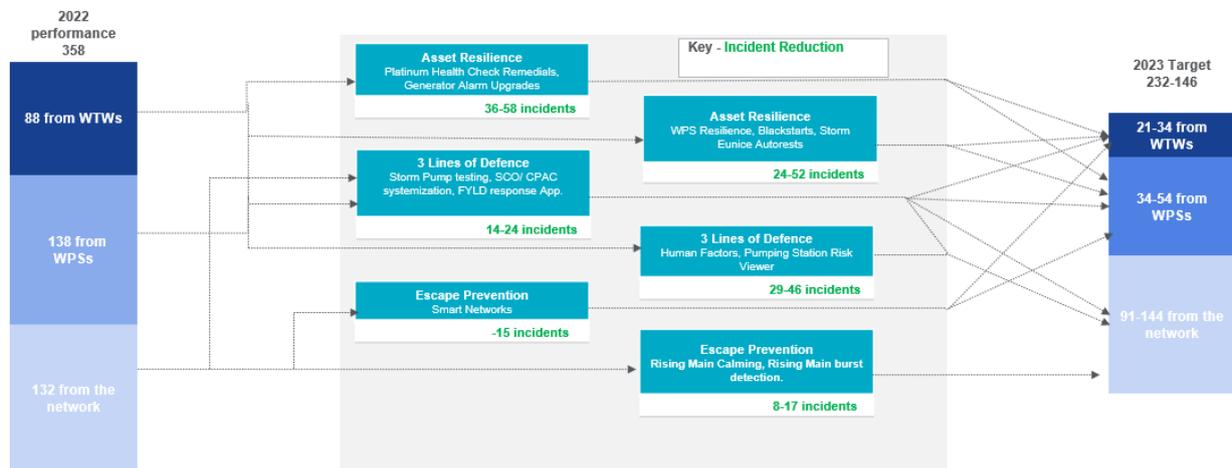


Figure 17 Glide path for 2023 PIRP from 2022 baseline

The calculations for a reduction in pollutions 2022 to 2023 from each workstream, are shown in figure 17. They demonstrate a realistic and achievable plan; built from the robust root cause analyses we carried out to make sure interventions are prioritised and targeted.

Learning from 2022 and previous years, we have selected four additional areas of work for 2023. These areas aim to build resilience in wet weather conditions with an emphasis on power resilience improvements, they cover the use of generator alarms, the installation of auto reset systems, maximising intelligence from PHC surveys, and expansion of the rising main calming programme.

The generator alarms project will focus on the upgrade of selected sites to make sure there is full visibility of generators in the control room, feeding into existing weather readiness processes. The root cause analysis identified a weakness in our generator assets, with 23 pollutions including those from Storm Eunice, occurring due to generator failure. Of those, 13 were from low fuel or battery failure, which could have been easily avoidable with the right data and alarms. This was one of the key things we learnt from dealing with Storm Eunice, and it is not a difficult project to implement.

A project has been developed focusing on the installation of auto reset systems for 47 sites identified following Storm Eunice. The project will install and commission an auto reset system, with an upgraded

telemetry unit if necessary. The project uses a custom-built mechanical and electrical design, making this project an off the shelf offer with proven benefits.

The wastewater pumping station resilience project will maximise intelligence from the PHC surveys to provide wastewater pumping station enhancements across the core areas of power, control, pumping and screening assets. This will deliver enhanced resilience on the next 60 wastewater pumping stations prioritised by risk, using in-house teams. The targeted scope includes pollution related health check remedials (screens, pumps, valves), black starts, control system checks including alarms, flow meter calibration and screen overtop alarms, as well as additional signals for Pumping Station Risk Viewer (PSRV) proactive alerting.

Following a review of 2022 performance and the link to increased storm flows, the Rising Main Calming programme has been expanded to include pressure monitoring and control, in addition to the existing programme.

Table 5 2023 PIRP Summary with expected benefit range

Task Name	Project Description	Start	Finish	2023 Cat3 Benefits
ASSET RESILIENCE	Platinum Health Check Remedials 52 sites	01.04.2022	31.10.2023	29 - 51
ASSET RESILIENCE	WPS Resilience	01.04.2023	31.12.2023	9 - 27
ASSET RESILIENCE	Black Start Programme	01.01.2023	31.12.2023	12 - 22
ASSET RESILIENCE	Generator Alarm Upgrades	01.04.2023	30.11.2023	5
ASSET RESILIENCE	Storm Eunice Sites Autoresets	01.04.2023	30.09.2023	3
ASSET RESILIENCE	Whole Network Permit Compliance	01.07.2022	30.01.2025	2
3 LINES OF DEFENCE	Pumping Station Risk Viewer	03.10.2022	29.03.2024	21 - 38
3 LINES OF DEFENCE	Human Factors (People & Process Improvements)	03.10.2022	31.12.2023	8
3 LINES OF DEFENCE	FYLD Pollution Response App	01.01.2023	31.12.2023	4
3 LINES OF DEFENCE	Sewage Pump Performance Testing	03.04.2023	29.03.2024	6 - 13
3 LINES OF DEFENCE	Storm Pump Testing	01.12.2022	31.03.2024	2 - 5
3 LINES OF DEFENCE	SCO and CPAC process systemisation	01.11.2022	03.04.2023	2
3 LINES OF DEFENCE	Enhancing Line of Site to Operational Risk	01.01.2023	31.12.2023	-
ESCAPE PREVENTION	Smart Networks	01.01.2023	30.09.2023	15
ESCAPE PREVENTION	Rising Main Calming	01.05.2023	31.12.2023	5 - 10
ESCAPE PREVENTION	Root Ingress Surveys & Remedials	01.01.2023	31.12.2023	3
ESCAPE PREVENTION	Condition Based Sewer Cleaning	01.03.2023	31.12.2023	0 - 3
ESCAPE PREVENTION	Rising Main Burst Detection (Proof of Concept)	01.12.2022	31.12.2023	0 - 1

The 2023 programme with start and finish dates is shown in table 5. Some of these programmes began in 2022, with a few due for completion in 2024 and 2025. The programmes have been prioritised according to the benefits that will be delivered. Programme completion is being driven through weekly Director and Chief Operating Officer (COO) led meetings, with the focus on delivery of the plan and unblocking any obstacles for all initiatives.

Figure 18 shows the calculated reduction of pollutions to 2025. The key focus for 2023 is to achieve a run rate of less than two pollutions per week by year end, which will provide the baseline needed for the step changes in 2024 and 2025.

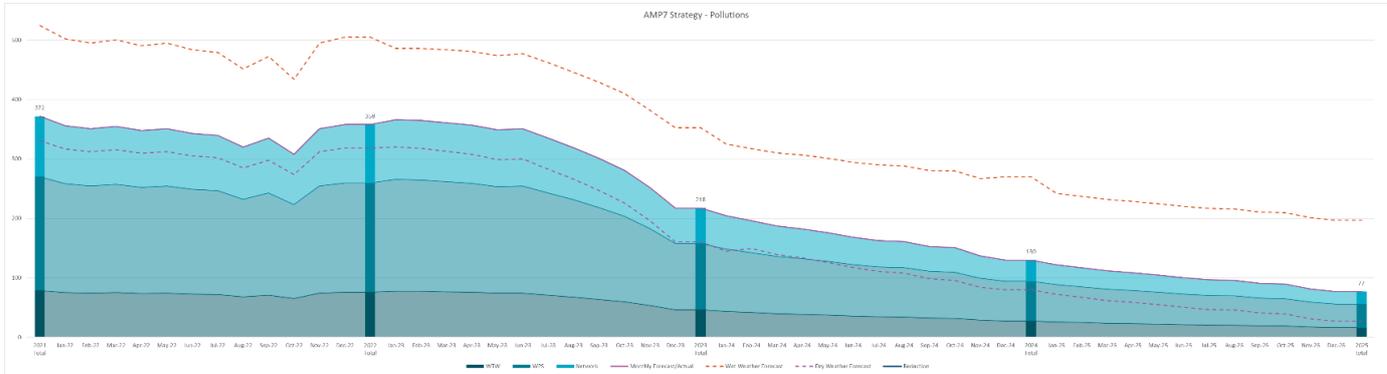


Figure 18 Glide path for pollution reduction to 2025

We have developed three key workstreams, these are asset resilience, three lines of defence and escape prevention.

Workstream 1 - Asset Resilience [figure 19]

Asset resilience initiatives include four new workstreams in 2023, these are wastewater pumping station resilience, generator alarms, Storm Eunice site auto resets and rising main calming enhancements including pressure monitoring.

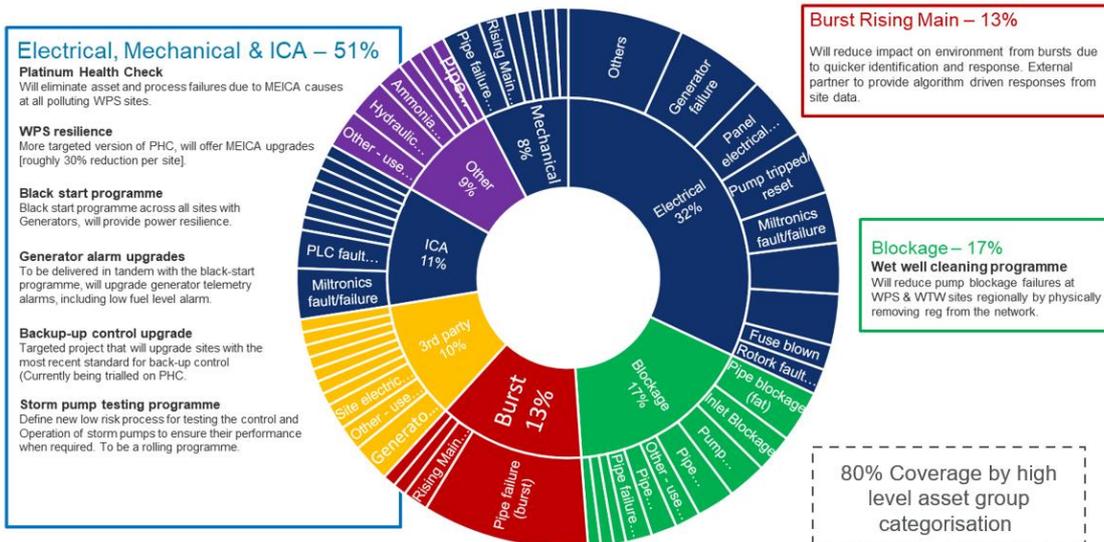


Figure 19 Asset resilience workstream and details of the planned initiatives for WTWs, WPSs and rising mains showing the link to root causes

Workstream 2 - Three Lines of Defence [figure 20]

Our 2023 PIRP three lines of defence workstream focuses on interventions to reduce pollutions via incident prevention, proactive interventions and pollution response and asset recovery. In addition to this we will be focussing on learning through our human factors workstream, sharing best practices and raising awareness of what the expected level of performance is.

The three lines of defence focuses on the people, processes and systems elements of the PIRP with significant change management programmes in place to make sure we can fully embed the existing 30-minute plans throughout the broader employee base, the control centre process, and the incident management processes.



1st Line Defence – Maintenance & Control of Risks

SCO & CPAC enhancements will ensure high risk activities are controlled.
Pump performance testing will ensure sites achieve permit pass forward flows through early detection of wear

2nd Line Defence – Proactive intervention

Proactive interventions resulting in increase in capability of Storm Harvester to provide

- Storm preparedness risk scanning
- Inlet blockage early detection
- Spill prediction and verification
- Enhanced consequence risk modelling

Increasing situational awareness by providing concise views of risks through effective and timely management information

3rd Line Defence – Reactive Intervention & Recovery

Pollution response by launching evidence capture app to provide platform to capture and store evidence.
Accelerating recovery post pollution by embedding post pollution recovery programme to include residual risk scanning and detailed recovery plans

Human Factors

Focus on quality commissioning and 1st time fixes by sharing best practices through dedicated cascades and raising awareness of what good looks like.
Sharing learning through post incident bulletins and driving that through process and training changes.

Strengthening Environmental Impact Assessment

Reinforcing 30 minute pollution response plan with Wastewater wide stand down briefing. Transition incident reporting to PCL's and introducing 1st and 2nd line assurance on environmental impact assessment. **Driving updates** to close incidents within 10 days.



Figure 20 Three Lines of Defence detailing initiatives that will improve pollution prevention, proactive response and speed of response showing link to root cause

Workstream 3 - Escape Prevention [figure 21]

The network digitalisation programme is the initiative with the most impact on reductions in pollutions from the foul sewer network. The programme includes optimising cleaning plans for the existing sewer network, to make sure the right amount of maintenance completed in targeted areas.

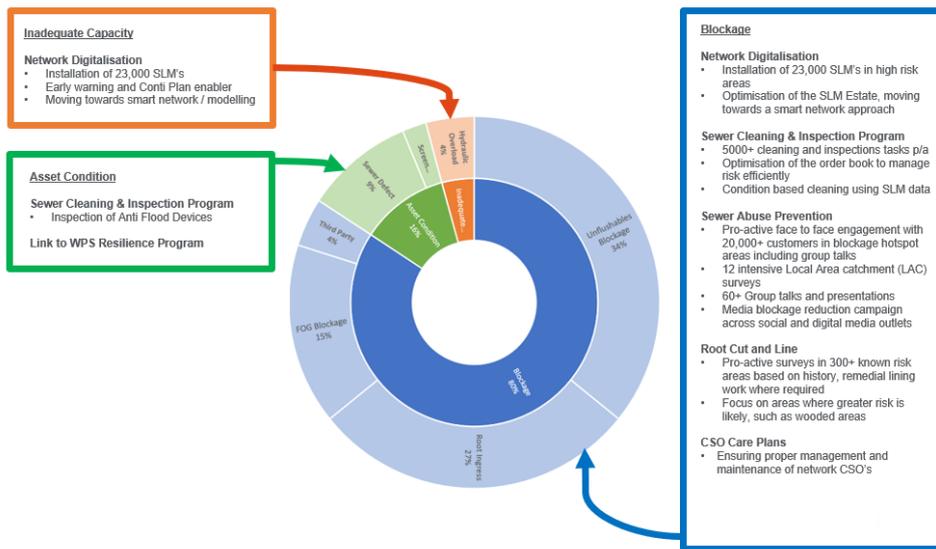


Figure 21 2023 PIRP Initiatives reducing escapes from the foul sewer network showing link to root cause

The 2023 PIRP focusses on moving existing time-based sewer cleaning, to condition-based cleaning (CBC). The scope will include a review of the top 700 out of 3481 cleaning tasks that are related to pollution or flooding. The suitability of sewer level monitor coverage will be assessed, and where coverage is found to be suitable, maintenance will be moved to CBC.

Where coverage is not suitable, additional manhole locations will be identified. The business case and installation plan for additional sewer level monitors will be built, and additional sewer level monitors will be installed. The outcomes will include an intelligent approach to network cleaning when required, the optimisation of resource deployment for these tasks, as well as visibility of the cleaning impact via the Storm Harvester platform.

Planned interventions and expected impact - serious pollutions

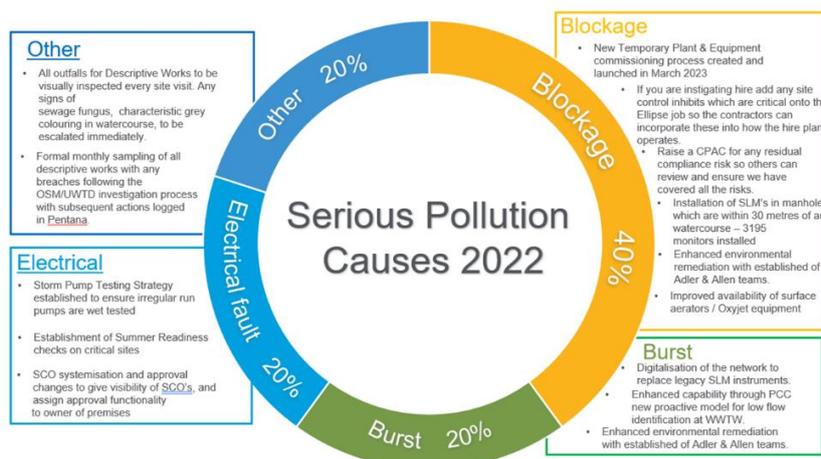


Figure 22 Planned interventions for serious pollutions

Figure 22 shows the planned interventions that will drive down serious pollutions with network digitalisation and the associated change programmes with the most impact.

Planned interventions and expected impact - clean water pollutions

There are 3 workstreams in the clean water pollution reduction plan.

Workstream 1 - Proactive maintenance/investment

- Burham lagoon cleaning.
- Testwood improvements to include site drainage, as well as total site upgrades.

Workstream 2 - Leakage

- Increased investment to reduce leakage, 50% of which relates to pressure management and calming the network down to stop bursts.

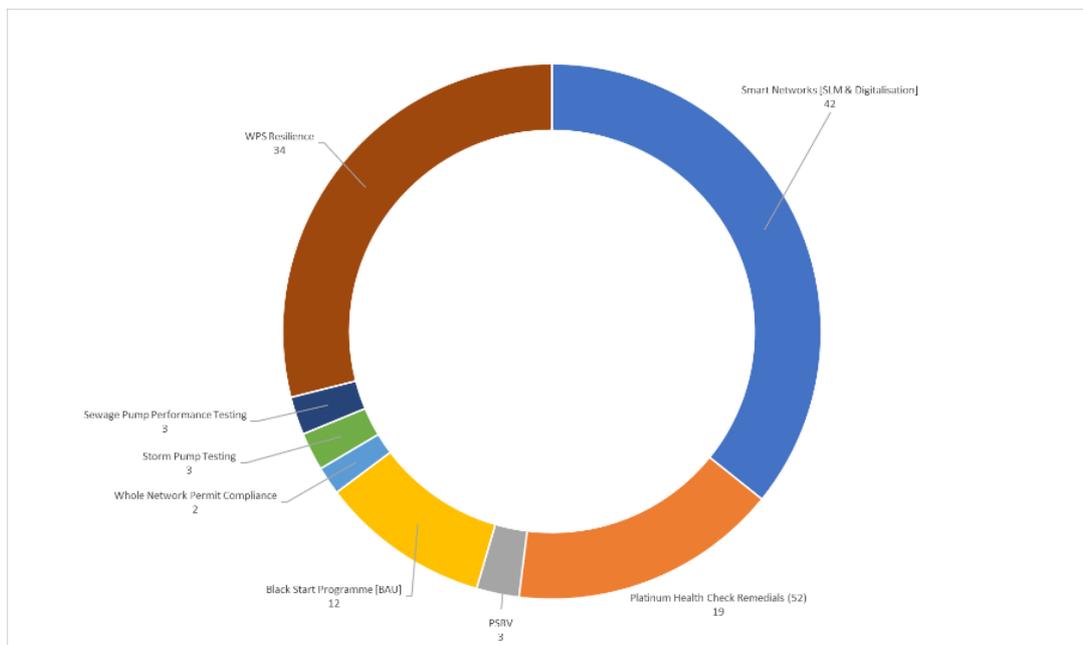
Workstream 3 - Pollution awareness, communications and training

- Increasing awareness within water teams of the various impacts of clean water pollution, to include communication plans and training, with a focus on how to mitigate or stop clean network pollutions.

Weather planning and resilience plans

Extreme weather events are becoming increasingly frequent due to climate change. As a water company, to limit the environmental impact from the problems this causes, it is critical to improve the asset base and continue to strengthen our preparedness processes.

Figure 23 2023 PIRP activities, with forecasted 2023 benefit, that will provide additional pollution resilience against weather events



Our analysis has shown the links between extreme weather events and pollution incidents, and we have built a variety of additional plans into our 2023 PIRP (figure 23). In fact, we have calculated that 79% of the benefits from the 2023 PIRP will directly contribute to improving resilience in weather events, with 70% of the PIRP 2023 benefits from these projects expected by the end of October 2023.

Our programme plans include a network cleaning and inspection programme, a PHC & wastewater pumping station resilience programme, network digitalisation and a proactive control centre, pump performance testing programme, a storm preparedness management process, and a network whole permit compliance project. This project is made up of audits to make sure the sites can meet all permit conditions.

2023 Pollution Incident Reduction Plan success measures

We will measure our success for the three key areas of focus using Key Performance Indicators (KPIs) shown in the table below.

Table 6 2023 PIRP Success Measures

No.	Task Name	Project Description	Leading KPIs	Measures of Success
1	ASSET RESILIENCE	Platinum Health Check Remedials 52 sites	Number of reported reliable alarms from alarm check on all completed sites	Reduction in reactive work orders and incidents on all completed sites
2	ASSET RESILIENCE	WPS Resilience	Number of reported reliable alarms from alarm check on all completed sites	Reduction in reactive work orders and improved data quality at chosen locations
3	ASSET RESILIENCE	Black Start Programme	Number of remedial issues found and resolved	Improved data quality at chosen locations
4	ASSET RESILIENCE	Generator Alarm Upgrades	Reduction in time to maintain and service our generator equipment	Increased resilience during storm events, Improved data quality & planning capability for our generator estate
5	ASSET RESILIENCE	Storm Eunice Sites Autoresets	Number of autoresets initiated	Improved data quality at chosen locations & more informed maintenance strategy
6	ASSET RESILIENCE	Whole Network Permit Compliance	Number of non-compliances identified and resolved	Reduction in flow control issues
7	3 LINES OF DEFENCE	Pumping Station Risk Viewer	Site work orders raised	Improved visibility and pro-active maintenance strategy
8	3 LINES OF DEFENCE	Human Factors (People & Process Improvements)	No. of Learning bulletins, interventions captured and implemented from Training Review meetings. % adoption of new temporary plant commissioning procedure	Reduction in the number of incidents involving temporary plant, reduction in incidents related to human error
9	3 LINES OF DEFENCE	FYLD Pollution Response App	Proportion of incidents captured and evidenced fully and within the required time windows	Decrease in the number of incidents with quality issues
10	3 LINES OF DEFENCE	Sewage Pump Performance Testing	% of pump performance tests performed and captured against planned visits	Increase in proactive jobs raised for pump refurbishments or wear part replacement
11	3 LINES OF DEFENCE	Storm Pump Testing	Number of storm pump tests completed versus programme	Decrease in number of incidents caused by failure of storm pumping assets
12	3 LINES OF DEFENCE	SCO and CPAC process systemisation	Number of SCO and CPAC's completed	Decrease in the number of incidents without the required paperwork in place
13	3 LINES OF DEFENCE	Enhancing Line of Site to Operational Risk	Completion of trial to generate business case for further roll out	Results of trial used to inform further strategic interventions
14	3 LINES OF DEFENCE	Strengthening Environmental Impact Assessments	Quality and timeliness of reporting to regulators and % completion of staff training	Decrease in the number of incidents with quality issues
15	ESCAPE PREVENTION	Smart Networks	Work orders raised and % of jobs with no fault found	Improved visibility and pro-active maintenance strategy
16	ESCAPE PREVENTION	Rising Main Calming	Completion of installations against project forecast	Reduction in number of burst rising mains
17	ESCAPE PREVENTION	Root Ingress Surveys & Remedials	Number of meters lined	Reduction in reactive work orders
18	ESCAPE PREVENTION	Condition Based Sewer cleaning	Number of tasks moved to CBC	Improved efficiency of sewer cleaning programme
19	ESCAPE PREVENTION	Rising Main Burst Detection (Proof of Concept)	Completion of trial and integration of pressure monitoring into Rising Main Calming Plan	Reduction in number of burst rising mains

Glossary

AMP7	The seventh asset management period planned by the UK water industry and running from 2020 to 2025
Rising Main	A pressurised pipe from a pumping station
Cat 1	CICS category 1 pollution incident – major, serious, persistent and/or extensive impact or effect on the environment, people and/or property
Cat 2	CICS category 2 pollution incident – significant impact or effect on the environment, people and/or property
Cat 3	CICS category 3 pollution incident – minor or minimal impact or effect on the environment, people and/or property
Cat4	CICS category 4 pollution incident – no impact on the environment
CBC	Condition Based Cleaning
CBM	Condition Based Monitoring
CICS	Common Incident Classification Scheme
COO	Chief Operating Officer
CPAC	Compliance Process Assessment & Controls
CSO	Combined Sewer Overflow
EA	Environment Agency
EA EPA	Environment Agency Environmental Performance Assessment
FOG	Fat, Oil and Grease
FS	Foul Sewer
FYLD	Proprietary name for the pollution response app
HEC	High environmental consequence
HRM	High risk manhole
ICA	Instrumentation, Control and Automation
MH	Manhole
NFF	No Fault Found
NRV	Non-Return Valve
OFWAT	The Water Services Regulation Authority
PHC	Platinum Health Check
PIRP	Pollution Incident Reduction Plan
PIRS+	Enhanced Pollution Investigation Report System
PR19	Ofwat's Price Review 2019
PR24	Ofwat's price review 2024
PSRV	Pumping station risk viewer
RCA	Root cause analysis
SCO	Safe Control of Operations

SLM	Sewer level monitor
SR	Self-reported incident
Unflushables	Items which should be disposed of in the bin, not the toilet.
WaSC	Water and Sewerage Companies
WSW	Water Supply Works
WPS	Wastewater Pumping Station
WTW	Wastewater Treatment Works