Pollution Incident Reduction Plan

July 2024

from Southern Water

Foreword

Our 2024 Pollution Incident Reduction Plan (PIRP) addresses a critical aspect of Southern Water's performance. It sets out how we will advance on the progress made under previous plans, and will help focus our activities as we strive to protect and enhance the environment and the communities we serve. We will reduce pollutions, not just because it matters so much to our customers and local communities, but because everyone in our company passionately shares this goal. That's why we're investing £451 million to maintain our wastewater network, to reduce overall pollution incidents by 67%, and to eliminate serious pollution incidents.

We're already making significant progress. In 2023-24, there were 234 Category 1-3 pollutions. That represents a 35% reduction in incidents compared to the previous year; over the past 5 years, we have more than halved pollution incidents. Since our first plan in 2020, environmental assessments and action plans have seen us reduce pollutions each year. However, while we have seen a reduction in the overall number of pollution incidents, in 2023 we saw an increase in the most serious category: this isn't acceptable, and we're committed to understanding the root causes of these incidents and putting in place the necessary actions to prevent them happening again.

This forensic approach to root cause analysis is giving us a greater understanding of the causes of pollutions, and where to focus our actions to achieve the maximum positive impact. The investment we've already made to reduce pollutions, boosted by our 2023 Turnaround Plan, is delivering change. While this progress hasn't come at the speed we'd hope (particularly around reducing serious pollutions), we've redoubled our efforts in 2024, building on the interventions which we know work and on learning from other water companies and across industry.

Pollutions typically occur when our sewers and equipment don't work as they should, either due to blockage or failure. We know that flushing wet wipes and pouring fats, oil and grease (FOG) down the drain are the biggest causes of sewer blockages; these now make up the largest proportion of our incidents. We've led the industry in deploying more than 23,000 sewer level monitors (SLMs), backed up by bespoke AI predictive technology and intensive cleaning programmes, and we're committed to making further significant reductions in this area. However, we're experiencing many challenges in our region, not least the wettest 18 months on record, which has meant very high levels of groundwater, and sometimes overwhelming amounts of water entering our sewer network in a short period of time.

Throughout our business, an intense focus on reducing pollutions is shaping our approach and the actions we take. As we continue to make progress, I'm confident that we're getting closer to where Southern Water's customers, stakeholders and employees fervently want us to be. I recognise there is a great deal more to do, but this plan will help us better protect our communities from pollutions, and improve the precious environment around us in this beautiful region.

Stay safe,

Lawrence Gosden
Chief Executive Officer
June 2024

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Executive Summary

We are moving into the fifth year of our Pollution Incident Reduction Plan (PIRP), continuing our work to drive down pollutions.

The 2024 plan continues to inform and guide our actions to reduce pollutions using the best methods, and with a focus on the activities producing the most impact. The plan shows the progress made in 2023 and the lessons learnt, before looking at the way ahead until 2025.

Under the plan, Southern Water's aim is to reduce the number of pollutions over the year by between 37 and 66 pollutions.

1.3 A review of 2023 pollution performance

Pollution incidents are measured annually, covering a full calendar year from January to December. The incidents are categorised by the Environment Agency (EA) for its Environmental Performance Assessment (EPA), and they are divided into Category 1, 2 or 3, according to the impact they have on the environment. Category 4 incidents are not included as there is no impact from these. The 2019 to 2023 results are shown in Table 1.

Pollution category	2019	2020	2021	2022	2023
Category 1: Major damage to environment, people and/or property	3	0	3	2	4
Category 2: Significant damage to environment, people and/or property	4	4	9	3	9
Category 3: Minor damage to environment, people and/or property	423	398	360	353	221
% Self-reported	87%	88%	90%	90%	69%
TOTAL	430	400	372	358	234

Table 1 – Performance Summary by Category 2019 to 2023

There was a 35% improvement in Category 3 pollutions in 2023, with the number of Category 3 pollutions falling from 353 to 221. The improvement in this category of pollutions reflects the focus on electrical, control and mechanical resilience, as well as the maturing of the pumping station proactive control centre.

In 2023 there was an increase in Category 1 and 2 or serious pollutions. Our analysis shows that the root cause of these serious pollutions has changed. While between 2019 and 2022 the most significant root causes of serious pollutions were electrical issues and blockages, in 2023 only one serious pollution was associated with either of these, being associated with electrical issues. This showed that our interventions, which had been mainly focused on high-risk pumping stations, were having an impact.

The main root causes for 2023 serious pollutions were rising main bursts and blockages, with six and four pollutions respectively. The next most significant root cause of this category of pollutions is "human factors", with three serious pollutions caused by incident response or site issues.

The self-reporting of pollutions – i.e. when we inform the EA of pollutions that we or our customers have spotted – saw a decline over the year. We have developed a self-reporting improvement plan and launched a new user-friendly online reporting tool to help customers report pollutions more easily, as well as improving business processes.

1.3   Analysing the root causes of pollutions

We analysed the root causes of pollutions during 2023 to shape the development of this year's Pollution Incident Reduction Plan.

The root cause analysis showed that the top root causes of the 234 Category 3 pollutions in 2023 were blockages from fat, oil and grease (FOG) and unflushable items (28%), burst rising mains (15%), mechanical faults (15%), electrical faults at Wastewater Treatment Works and Pumping Stations (12%), third party failures (1%) and control issues (1%).

This analysis has led us to divide the plan for this year into five key workstreams:
- Catastrophic Prevention
- Catastrophic Detection
- Chronic Prevention
- Chronic Detection
- Incident Response

The focus on the "three lines of defence" strategy from the previous plan continues, and we have increased resources to detect, identify and mitigate asset risks before they become issues, and to develop "second line of defence" (proactive) tools and capability.

1.3   Our 2024 plan

Our 2024 plan to reduce pollutions is based on lessons learnt from 2023. This allows us to prioritise initiatives with the greatest impact and use a more agile approach for their delivery. The plan gives a full overview of our 2023 pollution performance, including the root causes and looks ahead to the actions we will take during year five of the plan's delivery.

A highlight of our 2024 plan is to stretch our technological capability, harnessing the future potential of proactive control and using telemetry signals to enable us to take action before a risk becomes an issue. This will involve the introduction of a new condition-based monitoring technology (CBM), facilitating a more proactive approach to the monitoring and maintenance of the equipment and sites that make up our assets. This 2024 plan will deliver advanced CBM at the top 100 polluting sites in addition to trialling it with equipment, such as blowers used in wastewater treatment.

The 2024 plan contains 15 separate initiatives. The key projects driving benefits this year include:

Prevention
- Wastewater Pumping Station Resilience and Back up Control
- Samotics (advanced CBM for Wastewater Pumping Stations and Wastewater Treatment Works)
- Outstation Replacement
- Wastewater Treatment Works Flow Compliance

Detection
- CBM (Sentrix) models for telemetered assets including a final effluent early warning tool
- Rising Main burst detection
- SLM Data Frequency Optimisation

Incident Response and human factors
- Control pollution awareness and playbooks
- Incident management improvement plan
- Field rapid response teams

1. Pollution performance summary and trends

Understanding Category 1 to 3 pollutions from 2019 to 2023

The number of pollutions recorded in 2023 was 234. This is a 35% improvement on pollutions in the previous year, representing a significant step change in pollution reduction as the continuing Pollution Incident Reduction Plan initiatives start to mature and become sustained as business as usual.

The steady decrease in the number of pollutions year on year from 2019 is shown in Figure 1. This continuous reduction is part of our Turnaround Plan targets, and achieving these targets would enable us to improve to a three-star rating under the EA's Environmental Performance Assessment by 2025. These targets are kept under review.
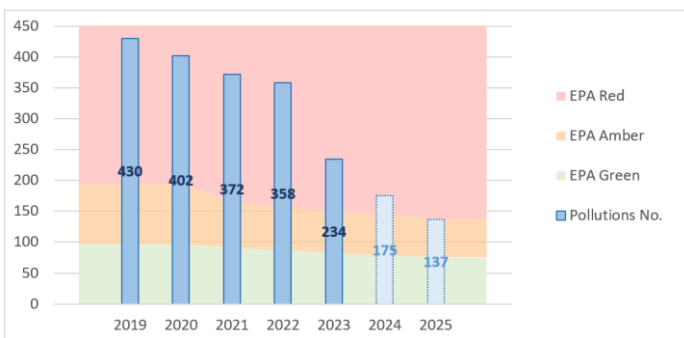

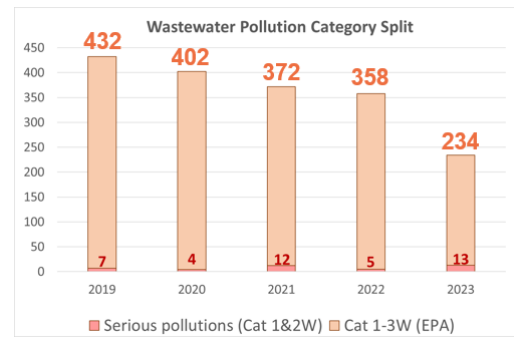Figure 1 Total Category 1 to 3 pollutions with EPA status

Figure 2 Total and serious pollutions

In the region we serve, there are 363 Wastewater Treatment Works, 3,499 Wastewater Pumping Stations and 39,373 km of sewer network. In 2023 there was a significant reduction in Category 3 pollutions across all types of assets, except for rising mains. However, while our Category 3 pollutions performance showed significant improvement, our Category 1 pollutions – the most serious - significantly worsened (see Figure 2).

To reduce the number and severity of serious pollutions, we have used insights from our root cause analysis. These insights have been used to shape our plans as part of a specific focus in our 2024 Pollution Incident Reduction Plan. The areas where a significant improvement can be seen across total pollution performance are in Rising Mains, Wastewater Pumping Stations and treatment works, as shown in Table 2. Foul sewers maintained their 2022 performance. Initiatives from the 2023 Pollution Incident Reduction Plan, such as Platinum Health Checks, Auto reset installations, Wastewater Pumping Station Resilience, Rising Main Calming, proactive alerts (CBM) and proactive control have all contributed to pollution reduction, having a positive impact on Wastewater Pumping Station performance.

Premise	Actual 2021	Actual 2022	Actual 2023
Foul Sewer (FS) / Combined Sewer Overflow (CSO)	76	94	102
Wastewater Pumping Station (WASTEWATER PUMPING STATION)	190	137	63
Wastewater Treatment Works (WWTW)	79	88	39
Rising Main (RM)	27	39	30
Totals	**372**	**358**	**234**

Table 2 – Performance Summary by Asset Class 2021 to 2023

Our analysis of the wastewater estate in Tables 3 and 4 (see annex) shows that the rate of 'newcomer' pollution sites – sites that polluted in 2023 with no previous history of polluting from 2019–22 – is 61%. This is an increase compared to previous years. The rate of repeat pollution sites – sites that polluted in 2022 and again in 2023 – has reduced to 25%.

Foul sewers have the largest proportion of newcomers at 92%, and the lowest repeat rate at 5%. This has resulted in challenges to work out the best locations for sewer level monitors. Wastewater Treatment Works have the lowest proportion of newcomer sites of 19% and the highest repeat rate at 70%.

This higher percentage of newcomer pollution sites or assets shows that the targeted Pollution Incident Reduction Plan investments are working. A revised approach for targeted interventions is now required for future Pollution Incident Reduction Plan initiatives which traditionally focussed on assets with historical pollutions, with newcomers not featuring in the ranking tools used for determining the scope of projects.

Out of the total number of sites that have polluted this year (193), a total of 25% (49) had previously polluted in 2022. To combat this, in 2023 greater focus was given to speed of resolution through operational grip and learning lessons. This included weekly sessions to evaluate root cause and a focus on the completion of investigation reports within two days of a pollution, for the Wastewater Networks teams.

While in 2022 poor pollution performance could be linked to times when there were periods of heavy rainfall (the reasons for this were analysed in our 2023 Pollution Incident Reduction Plan), this link has been significantly decoupled in 2023 (see Figure 3 in annex), in part due to increased asset resilience.

The increased robustness of equipment and infrastructure during heavy rain meant significant improvements in the resilience of our Wastewater Pumping Stations. This was particularly evident during Storm Ciarán (late October to early November 2023), in comparison to both Storm Eunice (February 2022) and the exceptionally heavy rainfall in November 2022. Both Platinum Health Checks and Wastewater Pumping Station Resilience are initiatives which effectively focused on the higher-risk sites, in addition to the wider reaching Auto Pump Reset (APR) programme, the Pumping Station Risk Viewer and Condition-based Monitoring across the Pumping Station estate.

The APR programme has been a particular success and has been included in the Mechanical and Electrical Design (MED) specification for pump installation. There are now 870 ARSs installed and 121 sites were reset during Storm Ciaran in October 2023, compared to a normal run rate of 35 sites. Operational activities as part of business-as-usual including two-day resolution for wastewater networks and clearance of the planned cleaning backlog by our contractors, has also had a positive impact.

Our Foul Sewer estate has not experienced the same degree of improvement in 2023 as other wastewater assets. We completed a deep dive into our network incident root causes and shared our insights in the 2023 Pollution Incident Reduction Plan critical review section.

Decoupling the link with the weather between 2022 and 2023, as well as less impact from extreme weather in 2023 compared to 2022, was the aim of our 2023 extreme weather plans, reducing spikes in pollution incidents. As Figure 4 shows, weeks of high rainfall in 2023 do not always have a corresponding increase in pollution incidents. The pollution incident spike in October 2023 started before the autumn storms, so they were influenced by other factors. In 2023 we saw a 65% decrease in weekly incidents with corresponding high rainfall events.

In 2023 there were higher than average temperatures in spring and autumn, however the summer was below average. The prevailing conditions in hot and dry periods of high strength and low dilution of wastewater will always cause a higher environmental impact. Figure 5 (see annex) shows that 2023 did not see the same peaks in Category 3 incidents associated with higher temperatures, as was seen in 2022. The interventions in the 2023 plan – which were informed by weather impacts seen in 2022 – had a positive impact and the

focus remains on sustaining this performance. We acknowledge that extreme weather events associated with climate change are here to stay, and we commit to continuing to adapt and improve our plans to improve resilience to extreme weather events.

Focusing on serious pollutions from 2019 to 2023

We recorded four Category 1 and nine Category 2 pollutions in 2023. This is a deterioration in performance compared to 2022 shown in Figure 6 below. Under the Environmental Performance Assessment (EPA), this will be given a red status in the RAG (red, amber, green) ranking. Despite this disappointing performance, our ambition is to focus on serious pollutions to meet our target forecast of reducing the number of serious pollutions to one by 2025.
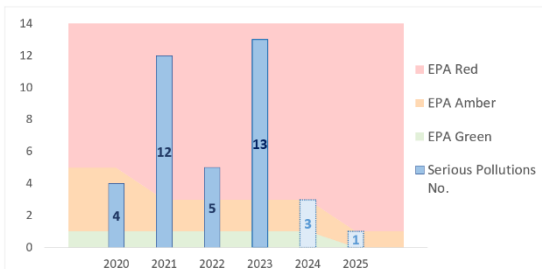

Figure 6 Actual and forecast serious pollutions 2019 to 2025
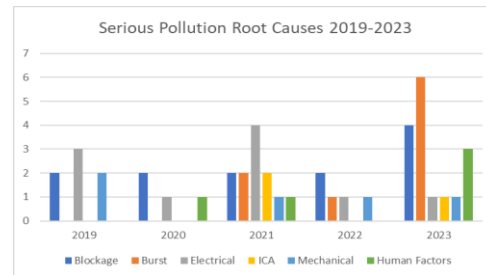
Figure 7 Serious pollution root cause 2019 to 2023

Although an increase in serious pollutions was seen in 2023, our analysis shows that the root cause for the serious pollutions has changed (see Figure 7 above). Between 2019 and 2022, the most significant root causes for serious pollutions were electrical and blockages, whereas in 2023 there was one serious pollution associated with electrical issues, showing that our interventions, particularly at high-risk pumping stations, had an impact.

Rising main bursts and blockages were the main root causes for 2023 serious pollutions, with six and four respectively. The next most significant root cause is Human Factors with three serious pollutions, which includes pollutions caused by incident response and site issues.

Clean water pollutions 2019 to 2023

The number of overall reported clean water incidents is dropping, with 269 events recorded in 2019 and just 173 incidents recorded last year. In 2023, we reported Category 3 incidents associated with the water distribution network and Water Supply Works reduced from 33 in 2022 to 16 in 2023 (see Figure 8 in the annex). We have, however, seen that the number of reactive events requiring a cut out repair – where the damaged section of pipe is removed – has increased year on year. This suggests that clean water pollutions are not being reported or recorded. A key workstream for 2024 is therefore to increase awareness of pollutions and the environmental impact of clean water discharges.

2. How effective were our previous interventions?

Total Category 1 to 3 pollutions

Across all our wastewater asset classes, our analysis has shown that the 2023 plan work completed to date has built on the solid platform set in 2022 with our 2023 plan delivering the planned outputs. However, we did not see the desired rate of pollution reduction in our networks. The Rising Main Calming initiative is on track to deliver benefits in 2024, so we must strengthen our plan to address pollution performance in our foul sewers.

Table 5 (see annex) summarises the end of year programme review. It shows 13 projects at green status, one key project at amber status and two minor projects at amber. The RAG (red, amber, green) status is categorised as follows: 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 the timeline, resulting in delays to realising the benefits. Figure 9 (see annex) shows the 2023 plan benefits forecast vs actual benefits from January to December 2023.

Progress with key 2023 plan projects is summarised as follows:

- **Platinum Health Checks (PHC) and Wastewater Pumping Station Resilience –** our asset improvement programmes have focussed on pumping stations to improve our worst performing assets and those in sensitive environmental locations:
  - A total of 45 out of 52 sites selected for Platinum Health Checks and remedials upgrades, were completed with an intensive care programme put in place for the remaining sites.
  - Improvements were made to Wastewater Pumping Station resilience, using a sprint style programme with in-house M&E (mechanical and electrical) expertise. There were 368 actions identified with 82 high risk issues. Of these, 145 actions were closed, including all the high pollution risk actions.
  - A total of 1837 pumping stations have now been upgraded to either silver or gold standard Conditioned-Based Monitoring (CBM).
  - A total of 40 sites out of 70 infrequently visited Wastewater Pumping Station sites have been upgraded to our current standard for telemetry alarm sets, with an additional 30 to be completed by mid-2024.

- **Waste Network Digitalisation and the Control Centre –** there are now 23,494 sewer level monitors (SLMs) deployed in the foul sewer network.
  - An additional 1% of manholes with Sewer level monitors were added in 2023, targeted on pollution risk and getting improved coverage at sensitive locations.
  - Of our 600,000 manholes, approximately 4% now have a monitor.
  - A dedicated team of six proactive control analysts, using a fully embedded Machine Learning AI platform to review exceptions and mobilise proactive interventions.

Given the low repeat rate of pollutions on the foul sewer network, we recognise that we need to continue to improve the effective targeting of pollutions, based on the location and the risk of pollution occurring. There are currently 4,878 manholes with sewer level monitors deployed and targeted for pollution, and this approach will continue into 2024. The following use cases were developed for new sewer level monitor

deployment and relocation of existing sewer level monitors, due to unresolvable signal issues over the course of 2023:

- CSOs – sensors are hand selected to be installed in a downstream manhole from the CSO's location, to give potential early warning of blockage growth that could impact the CSO.
- Pollutions – sites selected using historic pollution information or added post Phase 1 deployment due to recent pollution.
- Watercourses - selected using a rolling ball analysis on the impact of water and within a distance selection.

There were issues with communications from the sewer level monitors throughout 2023, and we are working with our suppliers to resolve these, with approximately 80% of total monitors now alerting. System optimisation is also planned, with increased data refresh times to enable alerts to be generated for fast forming blockages.

Rising Main Calming – we increased our resources to achieve our target of 30 rising mains fully calmed by the end of 2023 and 93 by the end of March 2024. Following a mid-year review, the programme was expanded to cover the highest risk (according to burst history) 98 rising mains.

Generator Alarm Upgrades – this programme has enabled visibility in the centre of fuel tank levels and other critical alarms while generators are running.

SCO/CPAC Process Systemisation – delays to the systemisation of the Compliance Process Assessment and Controls (CPAC) have not impacted benefits.

Condition-based Sewer Cleaning – we are moving to 24-hour coverage by our proactive team, to make sure that we can act quickly to address emerging risks 24/7, 365 days a year, making more than 2800 proactive interventions to date, in turn preventing around 560 escapes of sewage from the network.

Building on these foundations, further deployment of sensors targeting areas of environmental sensitivity and pollution pathways, will take place in 2024-25. It is anticipated that this will take the coverage of our sewer network from 4% of mapped manholes to around 5.5%. At the same time, new device options will be used to diversify our technology and provide the ability to collect different types of data, such as flow data.

The effectiveness of previous interventions can be seen in Table 6 (see Annex). Our 2023 plan had a phased Category 1 to 3 to water pollution reduction benefit of 119 and we achieved 124, representing a 35% reduction. While we saw a step-change reduction in our pumping stations and treatment works, we did not achieve the same outcome for our networks due to connectivity issues for sewer level monitors, the planned rising main calming programme being delayed at the start of the year and a high volume of newcomer sites.

Our aim is to reduce our foul sewer pollutions by 39% in 2024 from our 2023 performance. To achieve this, we have analysed our recent pollution data to understand the root causes so that we can address these gaps in the 2024 plan.

Keeping the plan's initiatives as part of our daily work

In 2023 we increased our capacity to keep the plan's initiatives as business-as-usual activities, by introducing a Sustainability Lead role. The role focuses on sustaining and embedding previous plan initiatives that had proven benefits:

- **Making the Blackstart process into business-as-usual activities –** this process was developed into a Maintenance Scheduled Task (MST), with a particular focus on high priority sites being tested

as part of seasonal readiness plans. It checks that our Wastewater Pumping Stations and Wastewater Treatment Works can effectively switch over to generation and switch back again when mains power is not available, by simulating mains power failures.

- **Installing Auto Reset Systems (ARS) –** the completion of these systems in 2023 saw them installed at 850 Wastewater Pumping Stations and 20 Wastewater Treatment Works on three to five different process areas. The targeted programme was based on what we learnt from Storm Eunice (2022).
- **Carrying out a wet well cleaning programme –** the 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 was then scheduled for the dryer months of 2023 and is in progress as business-as-usual.
- **Completing the sewer network cleaning programme –** this programme was successfully completed with 700km of sewers being cleaned, outperforming 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.
- **Making compliance process assessment checks (CPAC) –** this critical process was put in place in 2021. It followed several pollutions caused by insufficient governance of a critical process plant being taken off-line for maintenance and repair, and the need for associated compliance risk mitigation. Adherence to this process is tracked weekly to make sure embedment and that the benefits seen from this initiative are sustained.

Serious pollutions

The initiatives outlined in Table 6 (Effectiveness of Previous Interventions in 2022), will be effective for all types of pollutions. However, serious pollutions demand a particular focus on the detection and response elements of pollution response, to minimise the environmental impact of wastewater escapes. Over the course of 2023 we divided our key improvement activities for reducing serious pollutions into three areas; people, processes and systems:

Improvement activities - our people

- A total of 95 Wastewater Operational Managers attended a zero-compromise pollution day in October 2023. It focussed on a deep dive of seven serious pollutions looking at root case and potential solutions resulting in 366 improvement ideas. These included front line situational awareness, a knowledge gap for first responders and the ability to quickly locate the source of foul sewers.
- The 30-minute pollution plan was also improved during an accompanying workshop, adding upstream sampling and more specific instructions for impact assessments, as well as including clearer escalation routes.
- We continue to focus on the Pollution Control Lead role and responsibilities within the Operational Control centre, with continuous improvement initiatives such as playbooks on incident tankering, pollution management and alarm overviews, as well as improved Operational Continuity Plans (OCPs) based on the learning from rapid learning pollution reviews.

Improvement activities - our processes
-   We continue to use independent environmental expertise to provide background environmental profiles of high-risk areas, improving our ability to capture evidence and put in place remediation processes.
-   We have included metrics within the Wastewater Networks (WWN) and Wastewater Treatment (WWT) dashboards measuring adherence to the 30-minute plan and prompting reinforcement when required. Seasonal readiness processes have been continually improved as well as incident management improvements.

Improvement activities – our systems
-   Refinement of the available network digitalisation has taken place, to address emerging risk areas such as proximity to water course and surface water pathways. A proof-of-concept trial is in progress, investigating how additional signals from cameras can be included into existing reporting systems to validate discharges from our networks.
-   There are now 11 live Sentrix models (see Figure 10 in the appendix) that can be applied to improve both proactive 2nd line approach as well as reactive 3rd line detection with a further two models in development.
-   The pollution response app from FYLD was rolled out through our wastewater operations and our supply chain, which has provided transparency and visibility to our supply chain.

Focusing on foul sewers

The insights gained from a deep dive into our foul sewer network seen in Figure 11 (see annex) show that while we saw reductions in foul sewer blockage pollutions, this was offset by an increase in hydraulic pollutions, pointing to a need to address capacity issues in the network via our Flooding Task Force.

A total of 92% of foul sewer pollutions were newcomers, with 0.35% of total blockages due to FOG, unflushables and tree roots in the foul sewer network, resulting in 94 pollutions. The sewer level monitor programme removed 2,000 blockages, based on a historic run rate of 21K blockages per year, and a total of 3% of manholes have sewer level monitors in place.

Asset Location
Hydraulic root cause has had a significant impact on 2023 pollutions from the foul sewer network. Basing sewer level monitor location on mapped spill points has limitations as only 60% of network pollutions have a spill point asset identified against them. We have made our approach to sewer level monitor location more effective with future sewer level monitor deployment plans based on their impact on water courses and including environmental risk as a critical success factor.

Critical Review of SLM Deployment
While we have seen an improvement in those sewer pollutions due to blockages, there is an opportunity to further reduce this risk, using the lessons learned over the course of 2023:
-   Pollutions from the sewer network rarely happen in the same place twice, and there is a greater risk of serious pollution impact in sensitive areas, such as Sites of Special Scientific Interest (SSSIs) and RAMSAR sites - sites designated under the Ramsar Convention as a site of international importance.
-   Surface water sewers can act as a conduit or pathway to pollution.

- A higher density of sewer level monitors in environmentally sensitive locations is more valuable than general density in some areas.

Our review has enabled us to understand what we need to do next is to:
- deploy additional sewer level monitors to increase coverage, using environmental characteristics to target locations where additional installations will decrease the pollution risk
- increase density of coverage taking account of manhole proximity to any conduits or pathways
- continue with targeted customer education campaigns about FOG and unflushables.

2021 - 2023
Original BC. 22,000 devices. Multiple drivers including efficiency. History as a lead indicator for locations, plus a % density in priority LACs

2024
Phase 2 Deployment, pollution only driver. Increasing coverage, targeting environmentally sensitive areas and pathways

2024 - AMP8
Phase 3 Advanced risk model based on collecting, analysing and extrapolating much more data from actual incidents and external data sources

Figure 12 AMP 7 to AMP 8
SLM Deployment Strategy

Targeting Environmental Characteristics

Watercourses are a key concern, but the impact can be far greater in areas with an environmental designation. Understanding the performance of our networks in these areas is critical. Phase 2 of our sewer level monitor deployment will target Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), Special Protection Areas (SPA), chalk rivers, bathing waters and surface water sewers as pathways.
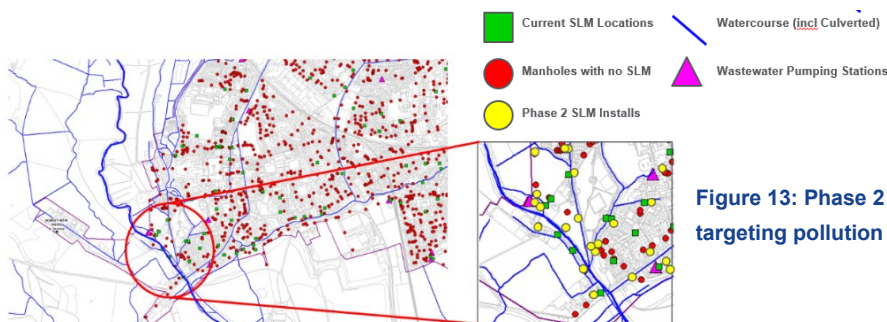
Selection conditions can be configured to achieve a balance of risk versus investment based on proximity to a given feature, such as 10m from an SSSI Boundary and coverage to a specified density, or 100% of manholes within an SSSI.

We have developed a model summarised in Table 7 (see annex), to analyse all 600,000 manholes to determine where they are in relation to the selected environmental characteristics. For example, we know that we have 812 foul manholes inside an SSSI boundary and 2,000 within 50m of a chalk river. Using this model, we can adjust the desired density of coverage for specific ranges of distance from these features to gain maximum mitigation of pollution risk.

Case Study: Increasing SLM coverage along the River Test

The River Test is a chalk stream in Hampshire. It rises at Ashe near Basingstoke and flows southwards for 40 miles to Southampton Water. Settlements on the Test include the towns of Stockbridge and Romsey. Much of the River Test is a 1,080-acre Site of Special Scientific Interest (SSSI). It is part of the Solent and Southampton Water Ramsar site – a wetland site designated under the Ramsar Convention as a site of international importance– and a Special Protection Area (SPA). The river is used for fly fishing for trout from its source to its tidal limit.

Figure 13 below shows the location of current sewer level monitors in Romsey in relation to the main river and local tributaries. Those indicated in yellow are part of Phase 2, to further reduce risk of pollution to this sensitive watercourse.

Current SLM Locations   Watercourse (incl Culverted)
Manholes with no SLM   Wastewater Pumping Stations
Phase 2 SLM Installs

Figure 13: Phase 2 Sewer level monitors in Romsey targeting pollution risk to watercourse

Working on weather resilience

As the number of pollution incidents declined during 2023, we were able to focus more efforts on planning for known seasonal variations that can cause issues for our systems and processes.

Bathing water – During 2023, our seasonal readiness plans put a focus on protecting our most sensitive bathing water locations during the summer and avoiding wet or cold weather-related pollutions during the winter months. For summer 2023 we:

- selected 23 high risk sites where a failure of our assets could cause a significant impact to our beach environment and put in place a series of actions to reduce the risk of failure, including bringing forward planned maintenance to before the bathing season, reviewing our critical spares, and testing our alarms and back-up systems
- updated our site continuity plans so that we would be able to respond more quickly to any failure, making sure that all generators were tested, as well as reviewing our need for manning during storm conditions.

In 2024, the list of high-risk sites with increased maintenance focus before the bathing season, has increased to 58, and we are currently tracking all the preventative maintenance we have planned. There are also a larger number of sites that could potentially impact a bathing water, and these are having a pre-season specific check to make sure any faults can be found and fixed.

During the winter of 2023, we:

- set up a gritting contract to make sure that all our key sites would remain safe and accessible during cold weather, including access roads and site roads
- put a focus on our storm tank operation, remotely monitoring our storm tanks to make sure they were emptying properly after rain, so they would be ready and waiting for the next spell of wet weather
- launched a Winter Checklist across our Wastewater Treatment Works and Wastewater Pumping Stations, prompting our Operational teams to check trace heating, lagging, lighting and drainage as well as making sure that generator fuel and grit were in stock where required.

Looking at human factors

When we explored human fallibility, following on from the creation of the human factors capability mentioned in the 2023 plan, this exploration expanded beyond post incident investigation into wider learning opportunities for us. This led to a business decision being made to expand the team in 2024, enabling us to create targeted solutions, optimising subject matter expertise and limiting future risk. Figure 14 (see annex) shows what we have found so far with actions not as planned (slip) remain the dominant root cause regarding human error.

Reducing clean water pollutions

There were three workstreams in the 2023 clean water pollution reduction plan:

Workstream 1 - Proactive maintenance/investment
- Testwood improvements to include site drainage, as well as total site upgrades: Tankering of waste discharges continues throughout 2023 and into 2024 at Testwood while refurbishment works are progressed.

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
- Continued reinforcement of pollution awareness within water teams of the impacts of clean water pollution with briefings and training into 2024 and 2025, with more work required in this area.

Studying river catchments

We have also studied river catchments to look for any trends in pollutions.

An analysis of Category 1 to 4 pollutions and their distribution within the 14 river catchments over 2023 shows that there are geographical differences (see Figure 15 in the annex). For example, the Adur and Ouse, and the Cuckmere and Pevensey catchments experienced fewer pollutions than the western catchments, such as East Hampshire. This has helped to inform the prioritisation of PIRP initiatives.

3. Root cause analysis – from data to insight

In 2020 we undertook a best practice review on causal analysis, which resulted in using Causal Assessment based on Systems Theory (CAST) to inform a systematic approach to our Root Cause Analysis (RCA). CAST shaped our approach towards the end-to-end mapping of the pollution incident process and Figure 16 (see annex) shows the pollution process to accurate root cause analysis.

We have evolved our Pollution Investigation Report System (PIRS) forms across the asset base to mature this principle to include 'The Five Whys' of root cause analysis, and we are continually improving on the quality of root cause data we obtain from incident investigations. In 2023 we implemented a 'Rule of Two' strategy for pollution investigations based on immediate two-day investigation, followed up by a more detailed PIRS investigation within two weeks. All actions were completed within two months where feasible. This rapid learning cycle continues to provide insights that enable the development of impactful reduction plans.

The Causal Analysis approach incorporated into our PIRS process remains an essential part of our programme and pollution root causes are mapped against three key steps which form the basis of the Pollution Incident Reduction Plans:
1. **Prevention**: proactive activity that helps prevent pollution (e.g. planned preventative maintenance and the proactive control centre)
2. **Detection**: how the pollution was detected (e.g. alarm, member of public)
3. **Response and repair**: speed and effectiveness of attendance on site to attempt to resolve the pollution and to collect evidence, as well as recovery and repair which looks at the performance of service recovery.

The 2024 plan categorises the type of environmental impact as either Catastrophic or Chronic and the root causes are associated with prevention, detection or response. The workstreams have been organised to resolve the root causes in these categories:

Catastrophic pollution – a high volume, immediate discharge over a period of minutes or hours. These are more likely to occur in highly populated urban locations on telemetered assets with high visibility. For example, a burst of a large diameter rising main resulting in a high-volume discharge over a short period of time.

Chronic pollution – a low volume, long term discharge over a period of weeks or months. These are more likely to occur in remote rural locations on non-telemetered assets with limited or no visibility. For example, a blockage or crack in the foul sewer network resulting in a small leak over a long period of time.

Category 1 to 3 pollution root cause summary for 2023
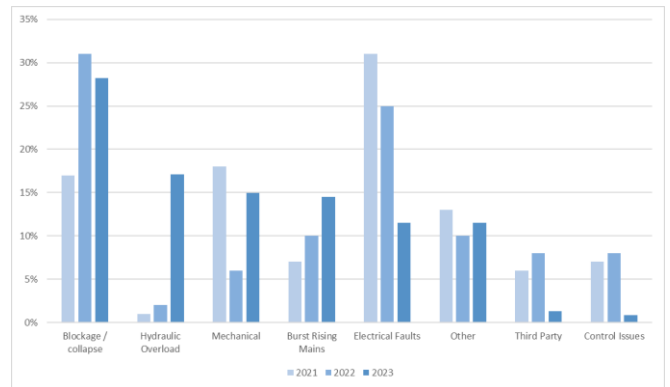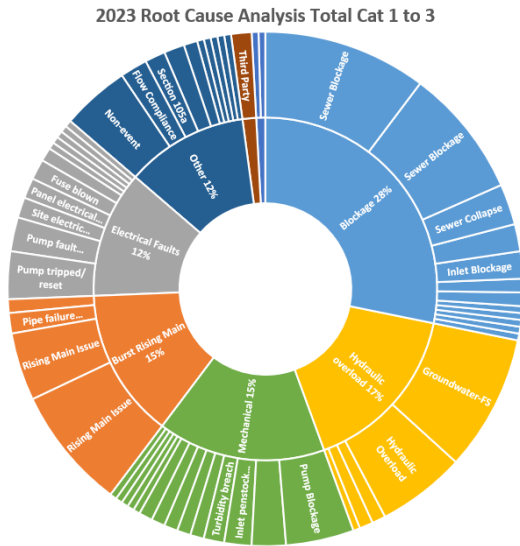
Figure 17: 2023 Root cause analyses total Category 1 to 3   **Figure 18: Comparison of root causes 2021 to 2023**

A summary of the detailed analysis of the root causes of pollutions in 2023 is shown in Figure 17. This shows the top root causes of pollutions were blockages from Fats, Oils & Grease (FOG) and unflushable items (28%), hydraulic overload (17%), burst rising mains (15%), mechanical faults (15%), electrical faults (12%) and Other (12%).

In 2023 significant progress was made using the plan's initiatives focussing on electrical and control failure modes with the installation of auto pump resets, Wastewater Pumping Station resilience and Platinum Health Check programmes. This has resulted in a 63% reduction in electrical failure mode and an 88% reduction in control failure modes. Significant increases were seen in 2023 in hydraulic root cause and burst rising mains, due to a wetter than average year with extreme rainfall levels from October to December shown in Figure 18. Pollution attributed to a blockage root cause has decreased by 9%, although this is still higher than was seen in 2021. Network digitalisation and finding the best locations for Sewer level monitors will continue to strengthen the proactive control centre which will address this failure mode.

2023 Category 1 to 3 catastrophic root cause review and the link to PIRP initiatives

The following infographics show the root causes of catastrophic pollutions linked to their impact (Figure 19) followed by 2023 and 2024 PIRP initiatives (Figure 20).

For catastrophic pollutions, we can see that bursts on rising mains and failure of plant on site remain the largest contributors to Category 1 to 3 pollutions due to catastrophic failure, followed by our ability to interpret and respond to issues quickly.

Figure 19:

Figure 20:

2023 Category 1 to 3 chronic root cause review and the link to PIRP initiatives

The root causes of chronic pollutions are shown in the following infographics linked to their impact (Figure 21) followed by flow through 2023 and new 2024 PIRP initiatives (Figure 22).
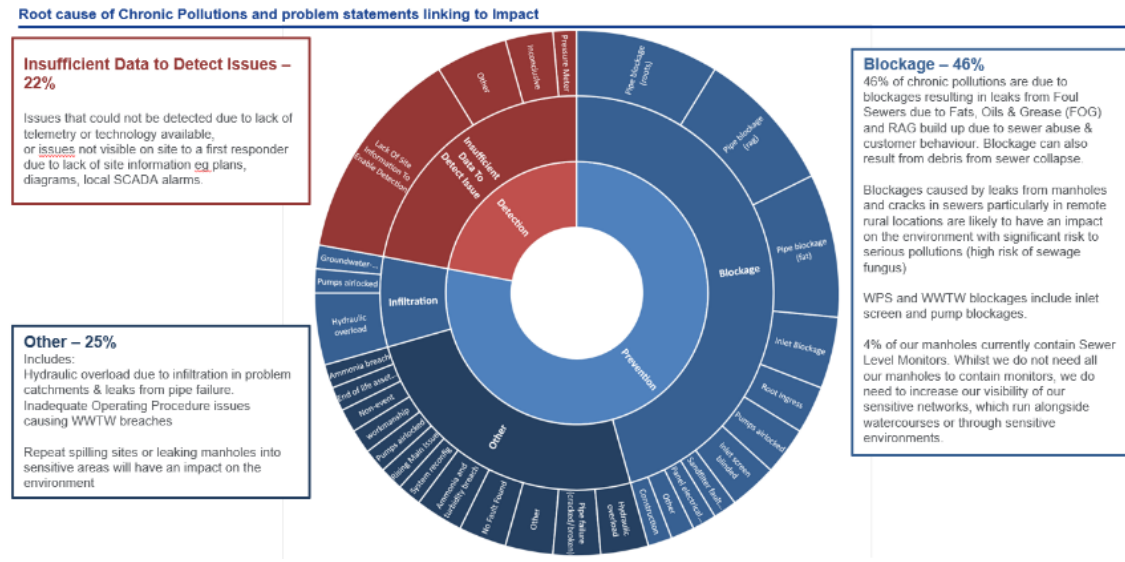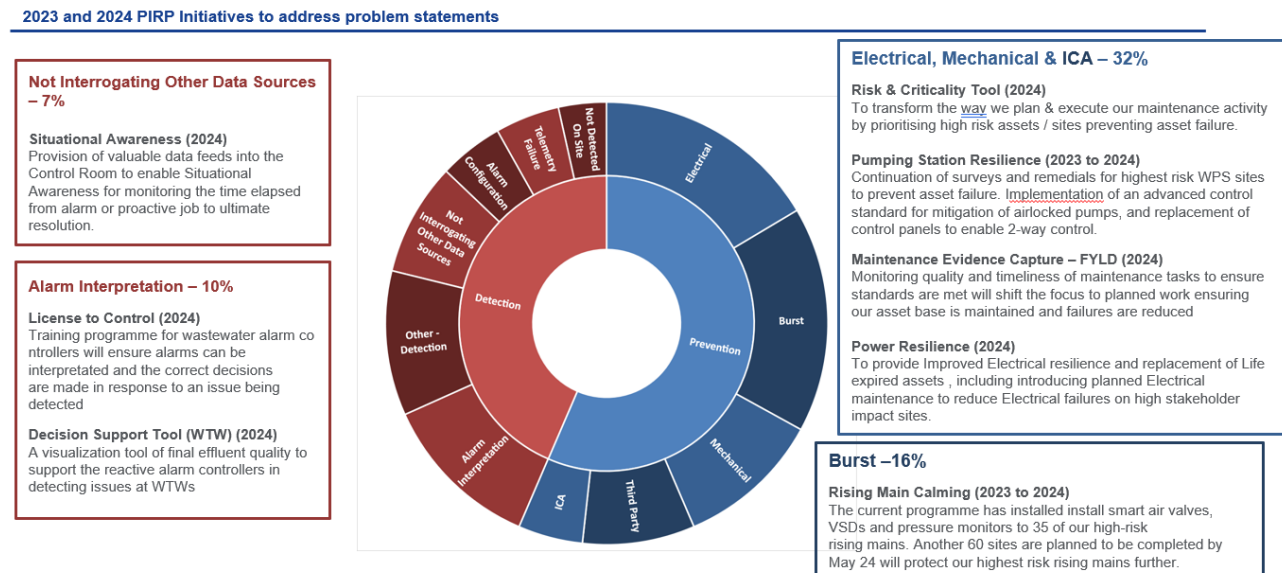
Figure 21

Root cause of Chronic Pollutions and problem statements linking to Impact

Insufficient Data to Detect Issues – 22%

Issues that could not be detected due to lack of telemetry or technology available, or issues not visible on site to a first responder due to lack of site information eg plans, diagrams, local SCADA alarms.

Other – 25%
Includes:
Hydraulic overload due to infiltration in problem catchments & leaks from pipe failure.
Inadequate Operating Procedure issues causing WWTW breaches

Repeat spilling sites or leaking manholes into sensitive areas will have an impact on the environment

Blockage – 46%
46% of chronic pollutions are due to blockages resulting in leaks from Foul Sewers due to Fats, Oils & Grease (FOG) and RAG build up due to sewer abuse & customer behaviour. Blockage can also result from debris from sewer collapse.

Blockages caused by leaks from manholes and cracks in sewers particularly in remote rural locations are likely to have an impact on the environment with significant risk to serious pollutions (high risk of sewage fungus).

WPS and WWTW blockages include inlet screen and pump blockages.

4% of our manholes currently contain Sewer Level Monitors. Whilst we do not need all our manholes to contain monitors, we do need to increase our visibility of our sensitive networks, which run alongside watercourses or through sensitive environments.

Figure 22

2023 and 2024 PIRP Initiatives to address problem statements

Not Interrogating Other Data Sources – 7%

Situational Awareness (2024)
Provision of valuable data feeds into the Control Room to enable Situational Awareness for monitoring the time elapsed from alarm or proactive job to ultimate resolution.

Alarm Interpretation – 10%

License to Control (2024)
Training programme for wastewater alarm controllers will ensure alarms can be interpreted and the correct decisions are made in response to an issue being detected

Decision Support Tool (WTW) (2024)
A visualization tool of final effluent quality to support the reactive alarm controllers in detecting issues at WTWs

Electrical, Mechanical & ICA – 32%

Risk & Criticality Tool (2024)
To transform the way we plan & execute our maintenance activity by prioritising high risk assets / sites preventing asset failure.

Pumping Station Resilience (2023 to 2024)
Continuation of surveys and remedials for highest risk WPS sites to prevent asset failure. Implementation of an advanced control standard for mitigation of airlocked pumps, and replacement of control panels to enable 2-way control.

Maintenance Evidence Capture – FYLD (2024)
Monitoring quality and timeliness of maintenance tasks to ensure standards are met will shift the focus to planned work ensuring our asset base is maintained and failures are reduced

Power Resilience (2024)
To provide Improved Electrical resilience and replacement of Life expired assets , including introducing planned Electrical maintenance to reduce Electrical failures on high stakeholder impact sites.

Burst –16%

Rising Main Calming (2023 to 2024)
The current programme has installed install smart air valves, VSDs and pressure monitors to 35 of our high-risk rising mains. Another 60 sites are planned to be completed by May 24 will protect our highest risk rising mains further.

2023 Category 1 to 3 response root cause review and the link to PIRP Initiatives

Following the root cause review, the following responses were put in place (Figure 23), with performance and incident management issues analysed (Figure 24).

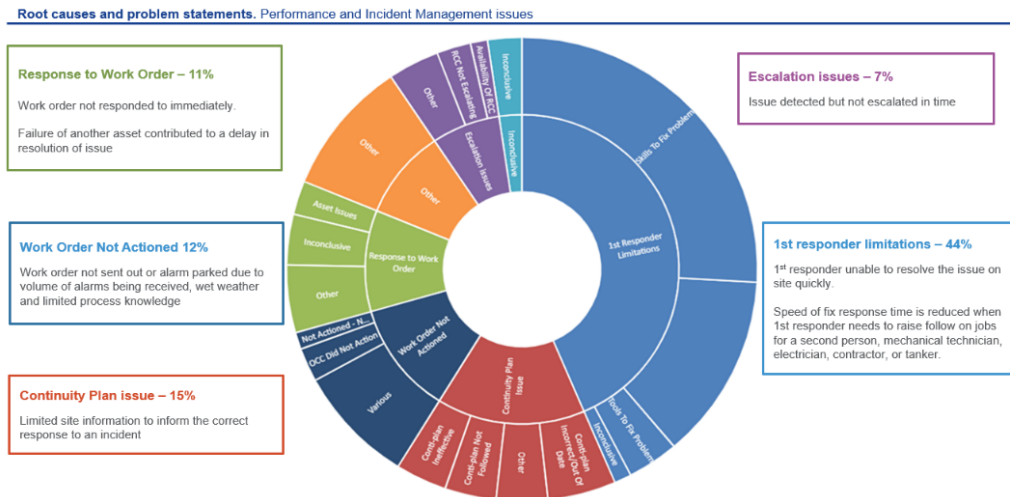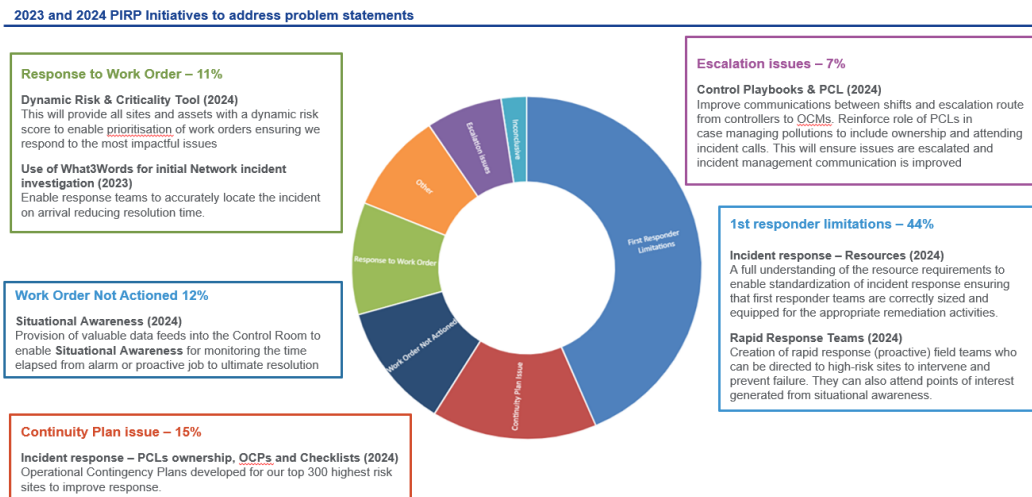**Figure 23: Root causes of response and repair problems**

Figure 24: The plan's initiatives to address problem statements associated with response root causes

A total of 44% of response root causes are due to the limitations on first responders in terms of the time it takes to attend a possible pollution and the speed of fixing any problems. These limitations will be addressed by the deployment of multi skilled, rapid response field teams.

The 2024 PIRP coverage for total pollutions and the link between root cause insights to actionable plan can be found in Table 8 (see annex).

Serious pollution root cause review and planned interventions for 2023

For every serious pollution a detailed investigation including a human factors review is carried out to inform the bow tie analysis and Director review. Work has been completed this year to improve the Director review process, ensuring effective lessons are learn from these incidents. Table 9 (see annex) details the location, asset type and high-level root cause of the serious pollution.

The root cause breakdown (see Figure 25 in the annex) shows that bursts (31%) and blockages (31%) were the main root causes for 2023 serious pollutions with human factors next (23%) – human factors cover pollutions caused by incident response and/or site issues – followed by both electrical (8%) and mechanical (8%). Figure 26 (see annex) shows the specific types of failures associated with each root cause. The serious pollution reduction plan has been built to address and resolve these failures. Table 10 (see annex) shows the 2024 planned coverage for serious pollutions and the link between root cause insights from each specific serious pollution into an actionable plan.

Clean water root cause review and planned interventions 2023

The 2024 plan builds on successful projects such as Wastewater Pumping Station resilience and improved condition-based monitoring schemes, which halved our pumping station pollutions between 2022 and 2023. We are also focusing on improved detection capabilities for sewers and burst rising mains, with a specific focus on serious pollutions and increasing our pollution self-reporting. Planned interventions are divided into three categories of root cause insights, these are detection, prevention and response (see Table 11 in the annex).

Using the pollution database, we can see that 87% of pollutions come from leaks, burst mains or pipes, with further analysis suggesting that pollution events come from reactive interruptions or reactive live repairs, with 'cut out' repairs needed for ring fractures, longitudinal splits and blow holes. While the joining pipes called 'ferrule' are the most common root cause of reactive events according to our data, ring fractures, longitudinal splits and blow holes are listed next.

4. Our 2024 Pollution Incident Reduction Plan

Planned interventions and expected benefits for Category 1-3 pollutions

In this fifth year of the Pollution Incident Reduction Plan strategy, we have used the root cause analysis of 2023 pollutions described in section 3 to focus our 2024 improvement plans and Figure 27 below shows the planned impact on the 2023 outturn.

Our 2024 Plan is forecasting to deliver a reduction of 37 to 66 pollutions in 2024. We estimate that the 2024 plan – plus flow through benefits of 28 from 2023 – will give a *phased* estimated 2024 benefit of 65 to 94 pollutions in total. Initiatives are estimated to bring a benefit reduction of a total of 20 pollutions by addressing chronic issues and a total of 23 for catastrophic issues. Incident response improvement initiatives are forecast to have total pollution benefits of 12 Category 1 to 3s.
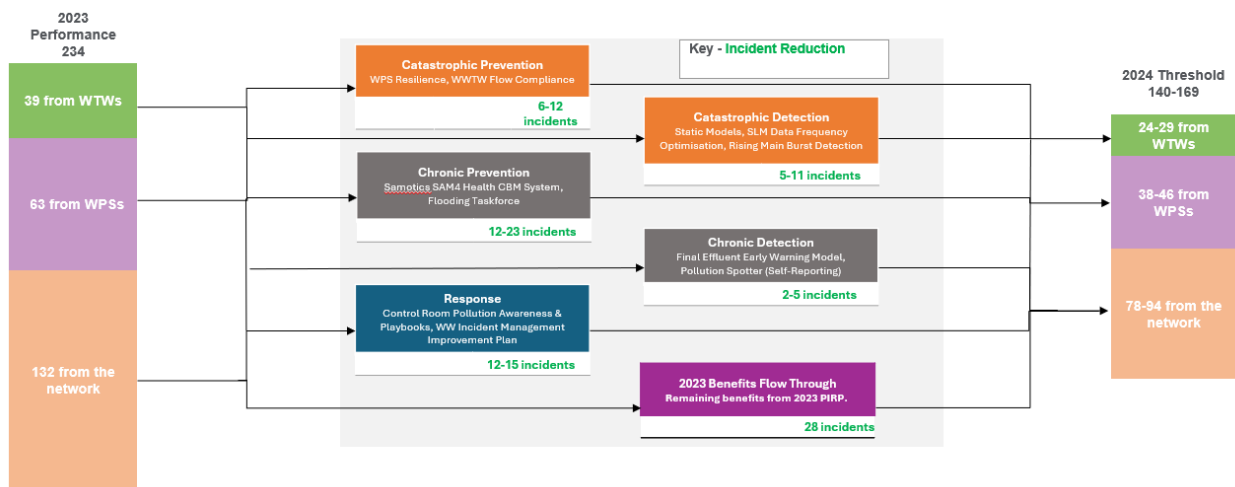
Figure 27: 2024 PIRP benefits impact on 2023 confirmed category 1 to 3 pollutions

The 2024 Pollution Incident Reduction Plan builds on the success of Wastewater Pumping Station resilience and rising main calming programmes and includes renewed focus on proactive control and incident response to address detection and response root causes.

The plan has been developed using the robust root cause analyses we carried out to make sure interventions are prioritised and targeted. The benefits will be delivered by building on the success of Wastewater Pumping Station, including the auto-reset system and back up control, as well as our rising main calming programme. The development and maturing of systems and processes within proactive control, as well as incident response improvements, will address detection and responses to root causes (see Table 12 in the annex for a 2024 plan summary showing the expected benefits).

The key projects driving 2024 benefits include:

Prevention
- Wastewater Pumping Station resilience and back-up control
- Samotics (Wastewater Pumping Station and Wastewater Treatment Works
- Outstation Replacement
- Wastewater Treatment Works Flow Compliance

Detection
- CBM (Sentrix) models for telemetered assets including a final effluent early warning tool
- Rising Main burst detection
- SLM Data Frequency Optimisation

Incident Response and human factors
- Control pollution awareness and playbooks
- Incident management improvement plan
- Field rapid response teams

The 2024 Pollution Incident Reduction Plan programme with start and finish dates is shown in Table 13 (see annex). Some of these programmes began in 2023, 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 though fortnightly Director-led meetings, with the focus on delivery of the plan and unblocking any obstacles for all initiatives. Figure 28 shows the calculated glide path for a reduction Category 1 to 3 pollutions to the beginning of the next strategic programming period 2025-30 (AMP 8). The key focus for

2024 is to achieve a run rate of less than 2.65 pollutions per week by December which will provide the baseline needed for the step change required in the strategic programming period for 2025-30 (AMP 8).

Case Studies

Case Study 1: Building on the success of the 2023 Wastewater Pumping Station resilience programme

The Wastewater Pumping Station resilience programme was designed to upgrade resilience in targeted areas looking at the key root causes of failure identified using the Pollution Investigation Report System (PIRS), which includes an in-depth investigation of our equipment and infrastructure. Site selection is prioritised, based on risk, and the criticality tool looks at repeat pollutions for both Category 3 and Category 4 pollutions, taking environmental sensitivity and the distance from receiving water courses into consideration.

Case Study 2: Samotics – bringing new technology into our Proactive Control Room

Detecting failures quickly at our works is key to avoiding any pollutions that may occur when something goes wrong. Samotics is a predictive maintenance system for AC motors and rotating equipment. Through AI-powered algorithms and a technique called electrical signature analysis (ESA), Samotics provides robust and high-quality detection of failures. Using this technology means that exception alerts are sent to our second line of defence proactive control centre teams, for dispatch out to resolution teams.

Samotics SAM4 dashboard alert.

Samotics SAM4 electrical signature analyser.
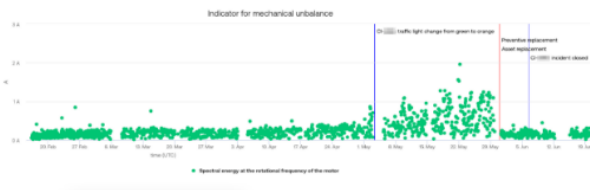
2024 Pollution Incident Reduction Plan success measures

We will measure our success for the five key areas of focus using the leading Key Performance Indicators (KPIs) shown in Table 14 (see annex).