

Drinking Water 2022

Quarter 1 January – March 2022

A report by the Chief Inspector of Drinking Water





Drinking water 2022

Public water supplies for England and Wales

Quarter 1

January – March 2022

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Compliance

Table 1: Microbiological failures at water treatment works January – March 2022

Parameter	Number of tests not meeting the standard
Coliform bacteria	9 (TMS 2, SVT 2, ANH 4, SEW 1)
Turbidity water treatment works	12

Anglian Water root cause investigation

Anglian Water reported a coliform failure at Isleham water treatment works in March 2022. This site is complex with 16 boreholes feeding into the main Isleham treatment process from six distinctly different remote supply sites. All six streams come together within the mixer tank at Isleham works.

The company's breach report lacked clarity on the investigation to establish the root cause of the contamination. No clear conclusions were found from the investigation. Any, or a combination of the separate treatment streams could be responsible for the coliform exceedance, which is the fourth bacteriological exceedance at this works since 2019.

The Inspectorate requested additional information and also held a workshop with the company on the contents of the breach reports. The investigations into the breach did not sequentially review the six supplying treatment streams into Isleham works, to thoroughly examine which stream/s were responsible for causing the exceedance.

The company received four recommendations requiring: -

- 1) enhanced monitoring on all the six individual supplying borehole streams and the thirteen in supply raw borehole sources to identify the source of contamination,
- 2) the installation of sample taps so that appropriate through process sampling could be conducted,
- 3) an investigation onto the flow patterns and stop/start activity from the boreholes.
- 4) borehole inspections, as five boreholes had not been surveyed in line with the company's documented inspection frequency.

These recommendations were given in order to ensure the company meet the requirements of regulation 18(2)(a) and to prevent further breaches of regulation 4. Companies are reminded to take a methodological approach when conducting investigations on complex sites with mixed sources to establish the source of the contamination and prevent the failure from reoccurring.

Northumbrian Water turbidity Mosswood water treatment works

In quarter one 2022 there were three turbidity failures from Northumbrian Water's Mosswood water treatment works. The turbidity standard is a critical component of effective disinfection.

- An exceedance in January on the Sunderland outlet had a result of 1.2 NTU.
- In March two further exceedances occurred on both the Sunderland and the Durham outlets with results of 7.7 and 3.3 NTU respectively.

The January exceedance investigation identified a number of contributory factors including a rapid gravity filter (RGF) outlet valve actuator failure, which meant that operators were manually driving the valve. The contact tanks are overdue an inspection and clean, and since the last inspection in 2009, the works has suffered three events relating to poor coagulation, twice in 2019 and once in 2021. It is possible that sediment may have accumulated in the contact tanks as a result of these events and contributed to the failures.

The works is covered by a tanks and service reservoir notice in addition to a hazard review notice. The company concluded that the turbidity failures were transient in nature with the most likely cause being sediment from historical particulates. Results from all three investigational samples returned with less than 0.26NTU from sample points across the works process and the downstream network. A remote operating vehicle (ROV) was used to survey both tanks on the site in addition to the pump sumps and the filter outlet channel. Whilst deposition in the tanks appeared minimal, the outlet pipework could not be inspected due to the higher flow velocity. The company are developing an inspection solution for the two separate outlet mains to determine the condition.

Companies are reminded to maintain tank cleaning and inspection regimes and consider the accessibility of outlet pipework. Inspection of outlet mains in addition to access for cleaning is important for maintaining regulatory compliance at the final sample point and within the downstream network. Inspection access for CCTV surveys for example, is advantageous for root cause identification.

Thames Water – Coliforms at Coppermills works

In February, Thames Water identified potential ingress around the ammonium sulphate dosing lines at Coppermills works. The company concluded this was the most likely cause of the coliform failure at the works. At the time of inspection, the dosing chambers were found to be flooded. As can be seen below, the dosing lines were not well sealed, and the flooding was likely caused by long term leaks on the pipework around the high lift pumping station. In addition, there is a risk that waste process water and surface water runoff contributed to the flooding.



Figure 1: Unsealed dosing lines at Coppermills works

Thames Water repaired the dosing points and minor repairs were subsequently carried out to address ingress into the contact tank.

Table 2: Microbiological failures at service reservoirs January - March 2022

Parameter	Number of tests not meeting the standard
<i>E. coli</i>	2 (SVT 1, NES 1)
Coliforms	10 (SVT 3, NES 2, YKS 2, ISC 1, HDC 1, SRN 1)

Northumbrian Water - Mount Joy service reservoir *E. coli*

On 17 January 2022 a weekly regulatory sample was reported to contain one coliform, which confirmed as *E. coli* on 19 January. UKHSA, the Inspectorate and the local health authority were notified. Investigatory resamples were taken on 18 January from the service reservoir, the upstream works (Mosswood works) and downstream consumer properties; including pre-sterilisation tap swabs, post sterilisation swabs and tank dip samples. All samples taken were microbiologically satisfactory. An external audit was carried out on 18 January and work was initiated to take the East side of the tank out of service (the West side was already out of service, having been so since October 2021 and undergoing refurbishment). The East side of the reservoir was removed from service on 19 January and a flood test was completed on 25 January 2022. Substantial ingress was found at three access hatches and two valve hatches. The company investigation concluded that the root cause was the substantial ingress on the tank. Both sides of the reservoir remained out of service until refurbishment works were completed and a satisfactory flood test had been concluded. This service reservoir does not form a part of Northumbrian Water's Tanks and Service Reservoir Notice as it was within its five-year inspection frequency target. The Inspectorate concluded that the company have carried out a thorough investigation into this

breach and have found the likely root cause. The company took appropriate action to protect public health and following remedial works the breach is unlikely to recur.

Severn Trent Water – *E. coli* at Castle Donington service reservoir

E.coli was detected at Castle Donington service reservoir in January. The service reservoir has two cells. The East Cell was isolated from supply in 2019, so following the *E.coli* detection on the failing West Cell, it could not be immediately removed from supply. The East Cell was flood tested and found to have ingress and so could not be returned to supply.

The company proceeded to rezone the network such that demand could be managed by other reservoirs in the vicinity, which enabled the failing West Cell to be isolated just short of three days after the failing sample had been taken. Ingress into the tank was identified and remedial work carried out.

The delay in removing the site from supply exposed consumers to increased microbiological risk and the Inspectorate made recommendations for the company to risk assess the return to supply of the East Cell, once appropriate remedial work had been undertaken and more widely to recommend that all reservoir and tower compartments that remained out of supply for a long period were risk assessed to ensure sufficient resilience remained within the supply network to protect public health. All companies are encouraged to similarly consider these resilience risks.

Table 3: Compliance in water supply zones – microbiological failures January – March 2022

Parameter	Number of tests not meeting the standard
<i>E. coli</i>	10
Clostridia	1
Coliforms	82

Severn Trent Water – telemetry case study

Whilst investigating an *E.coli* failure in Ladderedge supply zone in March, Severn Trent Water was unable to demonstrate that a UV reactor system at the supplying works was operating at the appropriate dose for disinfection. Whilst there is circumstantial evidence to demonstrate the reactor was operational and it is unlikely that this was the cause of the *E.coli* breach, this is poor practice and does not meet the regulatory requirement to continuously verify the disinfection process. The Inspectorate recommended that the company takes steps to ensure sufficient controls are in place to verify the UV dose. Possible improvements could include introducing a derived low dose alarm on the telemetry system,

but the choice of how to achieve this requirement remains with the company. The failure was due to a telemetry fault, which the company investigated further.

In addition to a communication issue between the site HMI and the Central eSCADA systems, Severn Trent discovered that the date and time of the information saved locally was significantly out of step and could not confirm with sufficient accuracy what the disinfection conditions were associated with the failing sample. The company subsequently corrected the time discrepancy and introduced a check between the PLC clock and the HMI clock, which assigns date/ time stamps on telemetered data, to ensure that this remains accurate going forward.

All companies are encouraged to review the date/ time settings on their site operating systems to correct for any drift and ensure that all records remain contemporaneous to events that happen on site. Companies are also encouraged to regularly check that communications with the remote sites and to promptly rectify any faults.

Representative samples from consumer taps

Issues with the representativeness of sampling were identified in compliance breaches reported by Bristol Water (February) and South West and Bournemouth Water (March).

For Bristol Water, a regulatory sample failed for coliform bacteria and was collected from a mixer tap with a pull down hose with a sprinkler type head. The presence of small plastic nozzles on the pull down head posed a microbiological risk as organic particles and detritus can accumulate inside and around the nozzles. The flexible hose had also been noted as repaired by the consumer with duct tape to help patch a leak.



Figure 2: Photos of kitchen tap and hose

The Inspectorate reminded the company of the requirements of part 6.4 of ‘The Microbiology of Drinking Water (2010) – Part 2 – Practices and Procedures for Sampling’ that states “taps at domestic properties should, ideally, be in good repair and should supply water from a pipe connected directly to the water main”.

A recommendation was raised under regulation 16 for the company to review the training and guidance given to samplers on the appropriateness of taps used for regulatory sampling purposes to ensure samples collected are representative of the quality of the water being supplied.

Similarly, a recommendation was also issued to South West and Bournemouth following a sample which contained coliform bacteria and was taken from a tap which had a plastic insert. Plastic aerator inserts can also harbour bacterial growth and from the information provided in the breach reports it was not clear whether the tap could have been reasonable have been removed. The Inspectorate recommended the company reviews its sampling procedures to include sufficient guidance/steps for samplers to take where tap inserts and attachments are present to help ensure compliance with regulation 16.

United Utilities timeliness of resampling

In the UUT Gt Harwood/Rishton zone a result of 1 coliform/100 mL was recorded in a regulatory sample from a consumer property. Resamples including pre and post disinfection samples and swabs were taken the next day and found to be satisfactory, however no samples were taken from neighbouring properties until six days after the original detection. Under regulation 18 companies are required to determine the extent of regulatory breaches. Therefore, a recommendation was issued in relation to the sampling time to determine the extent of the failure. Companies are reminded to ensure sample responses identify the extent of regulatory breaches, taking samples from the original failing property only is not an acceptable investigational approach.

Table 4: Chemical parameter failures January – March 2022

Parameter	Current standard or specified concentration ¹	Number of tests not meeting the standard
Odour	No abnormal change	12
Taste	No abnormal change	8
Aluminium	200µg/l	3
Benzo(a)pyrene	0.01µg/l	1
Copper	2mg/l	1
Iron	200µg/l	26
Lead	10µg/l	14
Manganese	50µg/l	5
Nickel	20µg/l	3

pH (Hydrogen ion)	6.5 – 9.5	1
Radon	100 Bq/l	1
Turbidity (at consumers' taps)	4NTU	3

Yorkshire Water iron sediment in distribution network

An iron failure in Yorkshire Water's Leeds HI Harewood and Shadwell 2019 zone in February 2022 resulted in a recommendation because limited action was taken to prevent a reoccurrence. The company investigation suggested that the public distribution system was the root cause as samples taken from the main were found to contain elevated levels of iron with pre-flush samples being 243,000 µg/L. The company flushed the main, but the iron concentration continued to be elevated in samples. Samples in March 2022 had concentrations of 1380 µg/L and 735 µg/L. The Inspectorate was unable to conclude that the failure was unlikely to recur and therefore a recommendation was given that the company completes a risk assessment of the local distribution network to determine mitigating actions to prevent future breaches.

Companies are reminded that if failures are likely to recur the Inspectorate expects actions to be taken to mitigate against the risk. Timelines of planned work and short-term mitigating actions are important to include in compliance breach reports to demonstrate that a wholesome water supply will be restored.

United Utilities Iron Failures

United Utilities had eight iron breaches between January and March 2022. United Utilities have a notice for discolouration covering the majority of their water quality zones (UUT 2020/00005). Five of the eight breaches were covered by this legal instrument as the company conducts root cause analysis for zonal areas covered by the notice and undertake improvements in network flushing and optimisation at treatment works in order to reduce appearance contacts and compliance failures. An iron failure of 349 µg/L in the Blackpool South zone was assessed as unlikely to recur following network flow reconfiguration after a closed valve on a four inch cast iron main was opened to increase turnover in the main. Resamples following the network operation change were satisfactory. This was the second exceedance in two months where a valve was found to be closed which could be opened to improve flow and turnover in a main. Companies are reminded to review network models on flow and water age to determine points of stagnation and increased risk of discolouration where main valves are closed and preventing turn over. Opening a closed valve can, in some circumstances, be a simple remedial action to prevent further regulatory breaches and maintain water quality.

Welsh Water iron exceedances

Seven iron exceedances occurred in Welsh Water's area of supply, of which three were covered by a legal instrument. The remaining four were assessed as trivial or unlikely to

recur, as the company has put in place measures to prevent recurrence, including adding some areas to the routine flushing programme. Whilst this addresses the issue in the short term, we encourage companies to carry out root cause analysis to address the long term risks, and to incorporate the long term solution into the company investment programme.

Events

The Inspectorate was notified of 91 events in Quarter 1. The following have significant learning to the wider industry.

Operational resilience at South East Water - impacts from Storm Eunice

February 2022 saw a period of adverse weather affecting England with three storms named (Dudley, Eunice and Franklin) causing challenging conditions for the operational activities of water companies. South East Water was particularly impacted, with Storm Eunice causing power outages at over 100 assets, ranging from boreholes, treatment works and booster stations across the company's supply area. The supply issues saw twelve service reservoirs empty when power supplies to supplying treatment works and booster stations were interrupted.

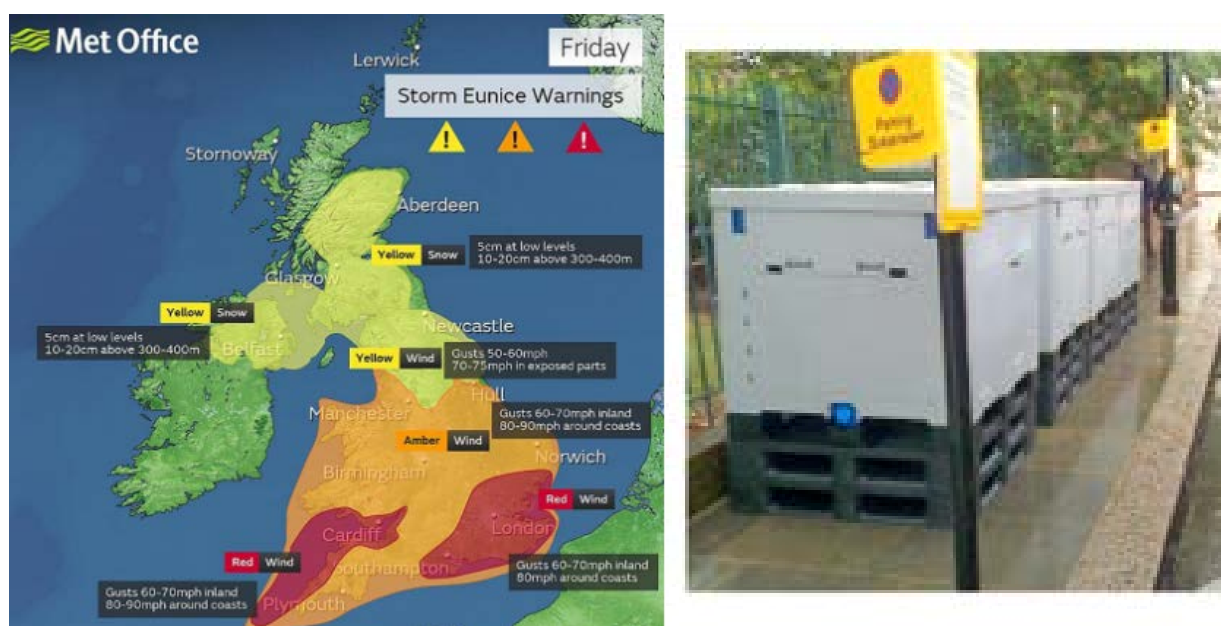


Figure 3: Met Office - Storm Eunice Warnings

The company estimates that around 85,000 consumers may have been impacted, with 119 water quality and 1938 water sufficiency contacts received across 11 water supply zones. The impact and consumer contacts lasted for 10 days between 18 and 28 February 2022.

On 14 February 2022, the Met Office issued the first yellow weather warning for the approaching Storm Eunice. This was subsequently upgraded to an amber warning, and on 18 February a red weather warning was issued.

In response to the weather warnings, South East Water undertook emergency planning activities which included the following:

- Arranged extra generators for key sites
- Ensured all fuel stocks were adequate
- Ensured all service reservoir levels were satisfactory
- Organised additional staffing for the weekend (operations and customer centre)
- Raised awareness of possible risks across the whole company
- Closed company sites to visitors during red weather warning

On 18 February the company started to experience issues across its supply area. The company instigated a gold incident structure to oversee the response. The company experienced loss of power and fallen trees meant access to some sites was made difficult. 30 critical sites were placed on generator power and additional power generation facilities were brought in, and mutual aid requested. As the number of consumers who lost supply increased the company enacted its alternative supply plans and 12 bottled water stations were manned in critical areas.

Residual issues with power supplies were felt in the period after the storm had passed, with unreliable power supplies causing site shutdowns and power spikes causing issues with onsite control prolonging the effects of the initial disruption.

Following this event, the company will be conducting a full incident review, the outcomes of which and any identified improvements, in which the Inspectorate will be taking a close interest.

Whilst red and amber weather warnings are rare, the Inspectorate expects water companies to sufficiently plan for potential disruption caused by adverse weather, (including storms and high demand events caused by freeze-thaw or pro-longed/extreme heat), by having resilient power supplies, treatment systems and operational flexibility within distribution networks.

South East Water have been particularly impacted in recent years due to deficiencies in resilience of their operational systems, which can only be considered as a lack of effective planning and investment to counter the impacts of adverse weather. In August 2020 the company suffered from a high demand period which resulted in loss of supplies to consumers in the Sussex supply area, and prior to this in 2018 during the Beast from East. The board should take note of these recent events and use the forthcoming business

planning process to improve operational and network resilience to ensure that their consumers receive wholesome and sufficient supplies all year round.

The Inspectorate has recently issued its [Long-Term Planning Guidance](#) which sets out in more detail how water companies should be preparing for extreme weather and to improve resilience.

Dwr Cymru Welsh Water - Gaufron boil water advice following wrong connection.

In January 2022 Dwr Cymru Welsh Water identified that the booster pumps at Gaufron Water pumping station were not controlling as expected. A job to investigate this was raised, but this was not planned or undertaken until the following month. This found that the pressure in the network was higher than the output pressure from Gaufron pumping station and that residual chlorine readings downstream of Gaufron pumping station were low compared to the readings in the network. This anomaly was escalated and investigated further by the company. This revealed an ambiguous noise on the network, which was traced to a farm that had a connected spring fed private water supply. When this property was isolated from supply, the pressure dropped at Gaufron pumping station.



Figure 4: Cross connection point and meter

Consumers supplied from the same network were advised to boil their water until flushing had been carried out, and the chlorine residual had been restored to the expected concentrations. Sampling was then subsequently carried out to verify that the water was wholesome. No breaches of the regulatory standards were found in samples collected from the network, although, *E. coli* was detected in a sample collected from the spring source.

The Inspectorate concluded that the company's sampling response was inadequate as it was untimely and unrepresentative of the water at the time of the event. Since other recommendations related to sampling inadequacies had already been made on several occasions prior to this event, an undertaking was served on the company to ensure that root causes and the extent of any failure is ascertained.

The company was also recommended to review and update its procedure on identifying any ambiguous or spurious data, (pressure readings in this case) to ensure that investigations are initiated promptly.

DWR Cymru – newt found in distribution main – (Redwren event, 2022/8435)

In February 2022, contractors working for Dwr Cymru, Welsh Water discovered a live newt in a water main during a CCTV inspection of the network in the Mitchell Troy area (Redwren zone) of Monmouthshire.

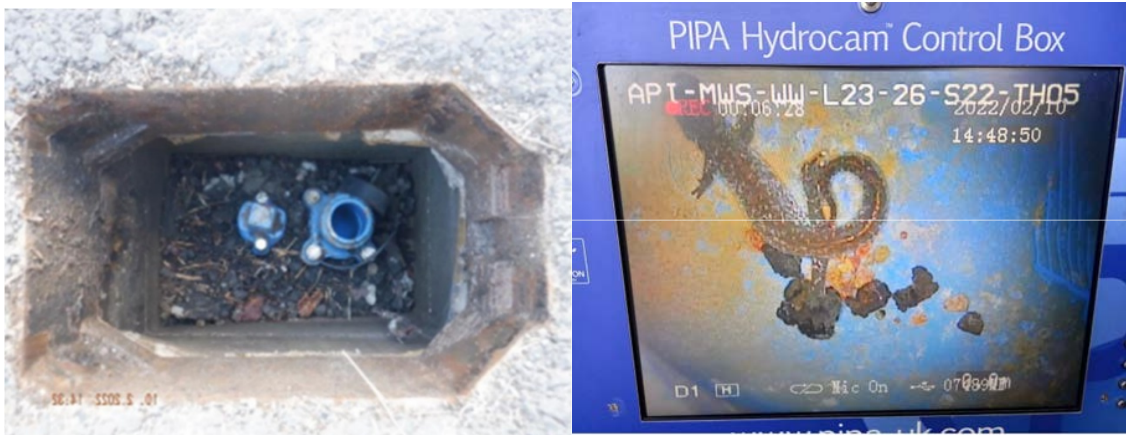


Figure 5: Hydrant chamber showing missing cap

Figure 6: Photo of newt observed during camera survey

This work was being carried out as part investigations to reduce discolouration risks and potential related to consumer contacts. This finding was reported by email to the company, but not acted upon until the following day when the matter was escalated and notified to the Inspectorate. The company removed the newt by flushing the main over a duration of 45 minutes, after which the animal was found to be dead. Routes of its access into the main were speculated but no definitive route was identified.

The Inspectorate concluded that the company's regulation 18 event sampling response was inadequate, and that it had failed to assess the potential risk to consumers for two days after the event. The assessment identified that whilst the contractor had carried out its own generic job risk assessment for the overall activity, it was not task specific and did not consider potential water quality hazards. The Inspectorate also concluded that the method statement for the job was not followed to the full and recommended that that a comprehensive review of all planned activities be carried out to ensure that in future water quality risk assessments are completed for work of this nature. A further recommendation was made to develop an overarching procedure to manage camera surveys and to carry out regular checks against this procedure to ensure they were being adequately applied.

The Inspectorate has since been minded to enforce in respect of sampling inadequacies identified during the assessment of this and the 2022 Gaufron boil water notice event. In

both events there was a failure to take samples representative of the risk posed to consumers during the event.

United Utilities Wigan discolouration

In January and March 2022 UUT reported two discolouration events in Wigan. The January event (2022/8421) was caused by flows from Rivington works and Lostock works being ramped up which exceeded the conditioned flow rate on the large diameter trunk main. The flow through the main was taken up to 33 ML/D at 19:30 on 28 January 2022. This resulted in a number of discolouration calls from the downstream district metered areas (DMAs). Through investigations the company confirmed that the increased flows in the trunk main resuspended historic deposits, resulting in discoloured water entering an upstream service reservoir and flowing out into supply to consumers. The contaminated service reservoir was isolated on the 29 January 2022 and a programme of network flushing was initiated to remove the discoloured water from supply.

Investigative samples were collected which showed regulatory breaches for aluminium, iron and manganese. All bacteriological samples were compliant. During the event the company took limited samples from effected assets and therefore a recommendation was given for the company to review their sampling protocols so that the cause and extent of the failure is identified. An additional two recommendations were given in regard to regulation 27 risk assessment, as the event could have been avoided if the flow changes had been adequately assessed before being executed, and if the maximum conditioned flow in the trunk main had been understood.

Companies are reminded to ensure that procedures for trunk mains include the maximum conditioned flow data so that adequate assessments of risk can be undertaken.

The March 2022 event in Wigan was linked to the same large diameter trunk main and the cleaning of a service reservoir on this trunk main. On 1 March 2022 the inlet valve of Montrey service reservoir was operated to facilitate cleaning and flush the floor of the service reservoir to remove sediment. The valve was controlled remotely via an actuator which failed to open the valve to the level requested by the controller. A larger volume of water entered the service reservoir than expected and the automatic control of the valve meant that this caused associated valves on the trunk main system to compensate for the increased flows. Atypical flows were registered at both ends of the trunk main system with booster pumps increasing from 23 ML/D to 65 ML/D over a five minute period. A total of 197 consumer contacts for discolouration were received from the Wigan area caused by the unexpected increase in flows within the trunk main. The post incident review concluded that the actuator had not been fully commissioned and should not have been used in automatic control. The review also identified that the existing procedures relating to the handover and commissioning of new installations were either not adhered to or were not clearly understood. The company took a large number of investigations samples during the

event which showed PCV breaches for iron, aluminium, manganese and turbidity. One sample additionally failed for *Clostridium perfringens*. All other samples were bacteriologically compliant.

The Inspectorate concluded that, in both events, the operatives working on the network were not fully informed on the assets that they were operating and the impact the operation would have on the downstream network. A recommendation was given for improvements to training for all networks staff. A recommendation was also given requiring the company to reinstate a cleaning and conditioning programme on the large diameter trunk main to limit the risks of reoccurrence. In relation to risk assessment and regulations 27 and 28 two recommendations were given for the company to revisit and reassess their current status of 'low risk' for discolouration on the trunk main in question. A further recommendation related to the company putting in place suitable measures to ensure that all large diameter trunk main operations have a risk assessment completed prior to work commencing to review all possible impacts from the planned activities on the downstream network. A final recommendation was given for the company to change their tank cleaning procedure and remove the use of the inlet valve as a means to facilitate a flow of water in the final cleaning of tanks. This is not considered good practice and companies are reminded that all tank cleaning and associated operations to facilitate the cleaning should be adequately assessed to prevent breaches of regulation 4.

The company is currently working under notice UUT 2020 00005 to address the risks of discolouration and supplying water that could be unwholesome. This notice requires enhanced monitoring and flushing within the affected water quality zones impacted by these events. The Inspectorate was satisfied that the company were meeting the terms of the notice however following the events required the company to repeat flushing exercises in the affected areas in order to prevent any further breaches of regulation 4 as the event would have caused a reseeding of the distribution network.

Lead audit shared learning

The Inspectorate audits the water industry according to a risk-based approach. In Quarter 1 2022 a technical audit of company lead strategies was completed.

The focus of the audit was the assurance of public health protection in response to lead failures and an assessment of the proactive strategy taken by companies with regards to lead. The audit included:

- an assessment of actions taken in response to failures such as, Water Fittings inspections, communication pipe checks, and replacement programmes,
- consumer advice and action trigger levels for investigations or event notifications.
- plumbosolvency control at water treatment works, and

- an examination of a selection of risk reports from the company's regulation 28 risk assessment submissions were evaluated.

The audit identified several common themes across the companies in England and Wales. These are outlined below.

On water quality investigations:

There was a variety of trigger levels across the industry to initiate further sampling and action. Some companies were found to be more proactive with others working only to the compliance standard of 10µg/L. A number of companies were leading the industry and initiating action on results of 3 µg/L and 4 µg/L. As best practice, **all** companies are encouraged to lower their internal response triggers to less than the PCV value of 10 µg/L.

Investigations commonly included random first draw samples and flushed samples which were used to determine whether turn over in the service pipe was sufficient to reduce the risk while remedial works were undertaken. A number of companies also included stagnation samples as part of their investigations. The Inspectorate reminds companies that samples taken after a period of no water use, for example collection early in the morning after no overnight use, provides a representative sample to assess the risk to the consumers within the property. This information enables appropriate advice to be given to the consumer to mitigate the risk of lead in the short term.

The issuing of do not drink advice was variable across the industry. Many companies worked on a case-by-case basis for issuing precautionary advice, completing a risk assessment of those within the property, for example prioritising pregnant women or young children. Some companies showed good practice and would issue do not drink advice if flushed samples remained above 10 µg/L. There were a number of companies who would not issue precautionary advice until the value of 100 µg/L was reached. These companies were required to review the threshold values for issuing precautionary health advice as there is no safe level of lead and the regulatory standard is 10 µg/L.

Many company investigations included identification of lead pipe material inside and outside of the home. These investigations included water fittings inspections and the use of lead solder test kits. The Inspectorate encourages water companies to undertake water fittings inspections, particularly where the root cause of lead sample failures cannot be identified from boundary excavations. Some companies had trained sampling staff to conduct basic water fittings checks so that following a breach of the lead standard or a consumer contact relating to lead at their property a simple inspection could be undertaken at the time of sampling. This is an example of good practice. A water fittings inspection should be considered for any lead failure at a public building and necessary enforcement action should be taken if contraventions are found relating to the presence of lead.

On replacing lead pipes and informing consumers:

The majority of companies missed opportunities when doing meter installations. Many companies did not record pipe materials and there was limited evidence of a proactive programme to replace lead pipes following meter exchanges. Whilst a minority number of companies would record materials and provide a leaflet on lead supply pipes to property owners through a card or letter, this demonstrates a missed opportunity generally across the industry. Information from meter installations could feed into risk assessments and inform future lead strategies or identify hot spots. The industry is encouraged to review their meter installation programmes and the data collected on lead pipe presence.

Lead communication pipe replacement was found to have varying service level agreements which ranged from days to months. Whilst the Inspectorate appreciates that there can be challenges with council permits and traffic management, water companies are reminded that it is a requirement under regulation 18(11) [England]/ regulation 18(9) [Wales] to as soon as practicable modify or replace company owned pipes and associated fittings that have the potential for contributing to lead in the water supplied to the premises, so as to eliminate that potential. One company was found to contribute £2000 to the cost of replacing the consumer- owned supply pipe and this was seen as a proactive initiative that is encouraged across the industry.

Website communications on lead were mixed with some pages easy to navigate to and others largely hidden from public view. Information held on webpages varied in detail and companies are encouraged to make webpages providing lead information easy to find, with the offer of a free lead test clearly stated.

On risk assessment and plumbosolvency control:

Companies used a variety of different information sources to inform lead risk assessments. For example, sample results were not the sole source of data with companies using phosphate dosing trends, lead pipe locations, and housing age hotspots, to input into predictive models. Some companies generated heat maps of lead risk to inform areas of enhanced sampling and future strategy direction.

As part of the audit a number of water treatment works that dosed phosphate were visited by the Inspectorate. Works were found to be in reasonable condition with recent phosphate monitoring installations and evidence of unreliable dosing rigs being replaced. However, the Inspectorate did identify that there were limited drop tests completed on dosing rigs and that companies were not consistently validating the dosed phosphate concentration with laboratory samples. As mentioned above, companies were often reliant upon zonal sample data to inform works dosing performance.

A number of concerns were raised around the control philosophy of phosphate dosing and monitoring at treatment works. Often companies were reliant upon pH monitors or

sampling within zones which would give a delayed response should there be an unidentified dosing issue. There were a small number of works where there was evidence that the company had ran out of phosphate, despite the zonal risk assessment for lead requiring phosphate to be dosed at all times as the main control measure. The lack of telemetry visibility, alarms and safeguards on dosing rigs was a concern and resulted in a number of recommendations across the industry relating to regulation 29 [England and Wales]. Checks once a week on site dosing rigs to identify and rectify dosing issues was a poor example of industry practice and companies relying on manual checks are encouraged to install suitable monitors and alarms. Response times to dosing alarms, where they were installed, was mixed with some companies responding within 24 hours and others over 48 hours. A response time of no more than 24 hours is considered good practice. Research indicates that lead leaching can begin in as little as 24 hours after phosphate dosing cessation (UKWIR 2016).

Enforcement

The Inspectorate publishes Legal Instruments on the website under [company improvement programmes](#). A summary of the legal instruments issued in this quarter is below.

Table 5: Legal instruments issued in Q1 2022

Type of legal instrument	Number	Companies
Regulation 28(4) notice relating to risks identified in water safety plan	5	Bristol Water Hafren Dyfrdwy Portsmouth Water South East Water South Staffordshire

Service reservoirs and contact tanks can present a significant risk to wholesomeness of the water they contain if they are not managed and maintained appropriately. Regular physical internal inspections are an essential management tool to assess the integrity of the structure and verify companies risk assessments. Technical guidance note 9 (TGN9) of the Principles of Water Supply Hygiene states that internal inspections should be carried out at a frequency no greater than every 10 years. The longer the time period between internal inspections, the greater the uncertainty around the integrity of the structure and the potential risk of ingress. The Inspectorate required the submission of tank inspection information under IL 01/2021, which is discussed in detail, in the 2021 Chief Inspector's Report series.

The Inspectorate has initiated enforcement under regulation 28(4), to ensure water storage assets with an inspection frequency >10 years are written into notices. As multiple

companies will ultimately receive such notices, the Inspectorate worked to formulate a standard notice template to ensure consistency across the water industry where possible but accepting that some difference will apply. The overall strategy for these notices is to ensure that all tanks have been physically internally inspected within the last 10 years, in line with TGN9. These notices are dynamic and require companies to review on at least an annual basis the tanks that are outside of the 10-year inspection frequency and add any additional tanks to the notice. While incentivising companies to ensure that, at the very least, the 10-year inspection frequency is met, these notices require companies to develop and implement a risk-based approach to determining the frequency of internal inspection and cleans for all tanks.

A regulation 28(4) notice was served on Bristol Water in January 2022 for Montpelier service reservoir 2. The reservoir was the only tank identified in the data return from IL 01/2021 for this company exceeding the recommended 10-year frequency for physical internal inspection. The notice expedited the isolation, internal inspection and clean of the reservoir, which was completed by the company in February 2022, reducing the risk of potential ingress and subsequent risk of unwholesome water for 59,332 consumers.

Following Hafren Dyfrdwy's submission relating to IL 01/2021, 14 service reservoirs and water storage tanks were identified as exceeding the 10-year internal inspection frequency, and for several of these tanks, the company are unable to remove these from supply without significant risk of impact to consumers. Therefore, a regulation 28(4) notice was served on the company for service reservoir and treated water tank inspections, to ensure the potential risk of ingress to a population of at least 189,436 consumers is mitigated as supply should not avoid mitigating water quality risks. The notice requires regular updates with any additional tanks that fall outside of the recommended 10-year inspection frequency added to the notice. Therefore, it is the prerogative of the company to ensure that no further tanks exceed the recommended 10-year internal inspection frequency.

A regulation 28(4) notice was issued for Portsmouth Water's Itchen water treatment works to review and improve the treatment process. This Notice follows on from compliance failures and an unsatisfactory audit that have been previously reported in the 2021 quarterly Chief Inspector's Reports. The notice requires a full end-to-end process review ('hazrev') to be completed of the treatment works, as well as investigations into potential aluminium seeding of the network. The requirements of the notice are expansive, reflecting a time in the company's past where training and management were not sufficient to identify the deficiencies of the site. The company is within a change programme to address these wider cultural issues. The Itchen water treatment works notice in itself will secure necessary treatment and operation improvements at the site, benefiting the 269,219 population it supplies.

The Inspectorate undertook an audit of South East Waters Boxley, Charing and Halling reservoirs in September 2021. All the reservoirs visited were significantly outside of their 10-year inspection cycle. The Inspectorate considered there were unacceptable water quality risks associated with the company's inability to carry out internal physical inspections and should the structures need to be removed in an emergency, there will be network water quality risks due to not having completed the necessary downstream preparation work. The Inspectorate was concerned that the company is not making timely progress or the required investment to enable the service reservoirs to be removed safely from supply for inspection. The Inspectorate therefore served a regulation 28(4) Notice on 15 February 2022 upon all the company's reservoirs outside of the 10-year inspection time frame to undertake actions to ensure all reservoirs can be effectively removed from supply for sufficient time to ensure that an inspection and all remedial work can be carried out without causing risks to consumers within the 10-year inspection frequency cycle.

Following notification of the detection of perfluorooctane sulphonate levels in the source water for Sawston Mill treatment works (Duxford airfield), the Inspectorate served a notice under regulation 28(4), on South Staffordshire Water Plc. The notice requires the company to design and deliver a solution to mitigate the risks of per- and poly fluoroalkyl (PFAS) substances in the source water. The company had previously removed the treatment works from supply, but the notice contains a prohibition (under regulation 28(4)(d)), making it an offence to return the works to supply until sufficient mitigation is in place. This notice will benefit the 324,596 population supplied by this treatment works. The notice was served rapidly as information became available and is a rare example of the Inspectorate serving a notification of enforcement, putting the notice into force immediately, rather than through the usual 'minded to enforce' consultation process.

Closures

South West and Bournemouth Water submitted a closure for the Crownhill water treatment works scheme (SWB-2020-00005). This notice covered the replacement of Crownhill water treatment works with a new works, Mayflower, to the benefit of over 385,000 consumers. This is the first treatment works in England or Wales to use ceramic membranes welcoming a new phase of innovation in water treatment. The completion report demonstrated the company's phased approach of incrementally increasing supply from the new Mayflower water treatment works while concurrently decreasing supply from Crownhill. In November 2020, Crownhill water treatment works was retired from service.

During the phasing out of Crownhill, the company undertook enhanced monitoring of Mayflower and Crownhill final waters and associated supply zones. There was no change in consumer contacts in the associated supply zones.

Since Mayflower water treatment works has been the sole supply, the average final water TTHMs have reduced by 67% from 36 µg/l to 12 µg/l. The company reported average zonal

TTHMs have also reduced by 53% in ZPL3 and 54% in ZPL4, as well as a 53% reduction in TTHMs at Down Thomas service reservoir that is located at the end of the network.

There have been no final water pesticide exceedances since Mayflower has been in supply and the average total pesticide concentration has reduced by 73%. The completion report highlighted that the catchment management initiatives do not appear to have reduced the frequency of pesticide detections in the raw water and noted issues with intensified farming. The company were unable to conclude that Mayflower water treatment works will ensure the required level of pesticide removal or whether additional treatment will be required. The catchment management initiatives in the Tamar catchment are ongoing and are included in the company's GER catchment scheme. The challenge for the company moving forward will be to address ongoing pollution risks from intensified agriculture in the catchment.

Green Economic Recovery Schemes

Both Severn Trent Water and South West and Bournemouth Water are undertaking programmes of work under the Green Economic Recovery Initiative. For the work that relates to improvements in water quality, the Inspectorate made the decision not to formalise the delivery of these schemes under legal instruments, given the reporting requirements the companies have committed to other regulators. Instead, the Inspectorate will formally acknowledge the actions being undertaken by both companies in sets of Acknowledged Actions. The companies have agreed to provide regular updates on the progress of these schemes. Although Acknowledged Actions are not formal legal instruments, each scheme has been assigned a reference number to allow for tracking under the Inspectorate's business as usual process. The following section outlines the proposed work of each scheme.

Severn Trent Water are undertaking lead replacement trails in two areas of their supply region: Coventry and Shropshire. These pilot areas will be used for learning on issues such as customer engagement, exploring innovative pipe identification techniques and understanding the challenges around lead pipe replacement. One of the most challenging aspects the company have encountered so far is shared supply pipes, which constitute a high percentage of connections, particularly in the Coventry region and this is an area of significant learning. The company are documenting all learning as the programme develops and using it to form a strategy for future lead replacement programmes. These initial trial programmes shall benefit the 101,155 population supplied in these zones.

Severn Trent Water also signed up to undertake an ambitious programme to decarbonise water resources. The exact work being undertaken under this programme is still to be determined, but under consideration are nature-based pre-treatment of River Trent water, refurbishing the Witches Oak pumping station asset with an ambition to increase

biodiversity at the site, investigation of low chemical treatment options and the operation of pilot plants to investigate this.

One element of South West and Bournemouth Water's regional pilot scheme: 'Smarter Healthier Homes' is a proactive lead replacement project. The project directly tackles the ongoing consumer challenge relating to the risk lead pipes present to water quality. In combination with the Severn Trent Water scheme, these projects will provide valuable insights for the industry of the challenges of proactive lead replacement schemes, identify where issues may arise and highlight lessons learnt from these pilots to inform strategies dealing with the water quality risk from lead moving forward. The key areas the Inspectorate has identified for feedback from the company include consumer engagement strategies, pipe identification and replacement, data, costs, and lessons learnt. In addition to the GER scheme, the company are piloting another lead replacement scheme in Truro. The pilot has already commenced, identifying a number of pipe replacements in targeted areas. The company has already noted significant learning around the practicalities of consumer willingness for pipe replacement and the ability of the supply chain to effectively deliver street-by-street replacement in logistically challenging areas, where lead pipes are often prevalent.

South West and Bournemouth Water are undertaking a catchment management scheme under the Green Economic Recovery initiative. As well as catchment management over 9,000 hectares of Dartmoor catchment, the project also seeks to restore 1,000 hectares of peatland. The project will form a continuation of the company's 'Upstream Thinking' initiative, working with farmers in the targeted catchments to reduce pesticide risk. The nature-based solutions that constitute the company's GER Catchment Management scheme should improve raw water quality as well as providing improvements in the water storage, baseflows and reducing flood risk.

Research

In January 2022 the Inspectorate's research project on [Advanced Oxidative Treatment Processes Phase II](#) was completed. This was a phase 2 project following on from a study completed in 2018 by WRc which identified nine priority disinfection by-products (DBPs) that were of potential relevance and have the potential to form when water is treated using AOPs. This phase two study focused on the nine compounds (2-methoxy-4,6-dinitrophenol, 3,5-dinitrosalicylic acid, 2-Hydroxy-5-nitrobenzoic acid, 4-hydroxy-3-nitrobenzoic acid, 4-nitrocatechol, 2-nitrohydroquinone, 4-nitrobenzene-sulfonic acid, 4-nitrophthalic acid, 5-nitrovanillin).

There is a legal requirement for water companies to minimise DBPs in drinking water, as set out in the Water Supply (Water Quality) Regulations. This generally pertains to carbonaceous and chlorinated DBPs because of the widespread use of chlorination. The

Regulations define a maximum of 100 µg/L for four chlorinated and brominated trihalomethanes (THMs) in supplied drinking water. The identity of DBPs produced from AOP are not well reported and they are not specified in the Regulations. AOPs typically involve the generation and use of the hydroxyl radical ($\bullet\text{OH}$) as a strong oxidant to destroy compounds that cannot be oxidised by conventional oxidants such as oxygen and chlorine. Most commercial ultraviolet (UV)/oxidation processes involve generation of $\bullet\text{OH}$ through UV photolysis of conventional oxidants, including hydrogen peroxide and ozone (Murray and Parsons, 2004).

The aim of this phase 2 study was to confirm whether the nine DBPs are formed under controlled conditions, and if so whether these DBPs can be effectively removed by granular activated carbon (GAC) post AOP. The project developed analytical methodologies for the nine DBPs. Bench scale testing was completed assessing their removal by GAC and reported on the conditions which favoured their formation during AOP. The outcomes include a method of analysis with limits of 1 ng/L for seven of the compounds and 25 ng/L for the remaining two.

The bench scale study involved experiments with synthetic water samples spiked with natural organic matter, nitrate and alkalinity. These were exposed to photolysis as well as UV/hydrogen peroxide with low and medium pressure lamps. Samples of treated water collected from the post filter stage of 11 water treatment works (real waters) were treated with UV/hydrogen peroxide. Finally, the real waters were spiked with two of the AOP-DBPs that were formed during the AOP experiments to determine their removal using GAC.

Results from the photolysis experiments showed that none of the doses with either of the lights produced any of the nine DBPs at levels greater than the limits of detection. The AOP experiments showed that none of the nine DBPs of interest were detected at levels greater than 1 ng/L when using a medium-pressure lamp. The results using the low-pressure lamp did reveal formation of two of the compounds at levels close to or below the limit of detection. These were: 5.314 ng/L 4-nitrophthalic acid. For this compound the LOD was 25 ng/L and 1.233 ng/L 3,5-dinitrosalicylic acid. For this compound the LOD was 1 ng/L. 3,5-dinitrosalicylic acid was not found in the duplicate sample, so the result was not repeatable. The conditions of these experiments were taken forward to carry out experiments on treated water samples collected from water treatment works.

For the real water experiments, only one of the experiments yielded any of the nine DBPs under investigation. Water sample six produced 3.527 ng/L 4-nitrophthalic acid which is below the LOD of 25 ng/L for this compound. The conditions for this experiment were 500 mJ/cm² UV dose, 10 mg/L H₂O₂ dose. The duplicate did not show that this result was repeatable. The GAC experiments revealed that levels present after treatment by GAC were below the limits of detection for both compounds.

The study has shown that the nine DBPs do not form at significant levels during treatment by AOPs under a range of conditions. At the levels formed for two of the compounds, these were able to be removed by GAC at contact times (five and 10 minutes empty bed contact time (EBCT)) lower than those generally used in industry. The risk posed by these chemicals is minimal in the range of source waters investigated. As a precaution these N-DBPs should perhaps be measured in final waters where AOPs are implemented, once their operation has been established. Consideration should be given to the risk of the presence of these compounds as part of the drinking water safety planning process.

