



Drinking water 2018
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Foreword

Drinking water 2018 is the annual publication of the Chief Inspector of Drinking Water for England and Wales. It is published as a series of quarterly reports which cover public water supplies in England and Wales.

The report sets out to develop a source to tap approach in the supply of water, developing learning points from recent data, events and company strategies. It builds upon the strategic objective of DWI for wholesome and safe, clean drinking water to all consumers at all times.

The Chief Inspector's Report this quarter focusses on a series of surface water works audits among more regular features such as events and compliance failures. While the audits considered critical factors which may give rise to an increasing risk profile in the provision wholesome water if unmitigated, it also highlighted a wider underlying failure of water companies to embed learning and recommendations which have been in place for up to 30 years. Such shortcomings in an extreme circumstance could give rise to potential risks to health if unchecked.

Nearly 30 years on from the Badenoch Report in 1990 where it was stated that "a continuously monitoring turbidimeter in each filter should detect any significant dislodgement of particles" and "if only one turbidimeter monitors a combined filtrate, dislodgement may be hidden by dilution from other filters" together with the recommendation made in the Bouchier Report of 1998 where "...monitoring should include continuous turbidity measurement on the outlet of each filter...", examples are still inexplicably found where this recommended practice has not been acted upon. It is significant that at Hanningfield Works, operated by Essex and Suffolk Water, a site challenged with a heavy algal source causing poor performance of the clarification process, leading to increased solids loading onto and consequentially poor performance of the rapid gravity filtration, the company is reliant on combined turbidity monitors for each bank of eight filters. No auto shutdowns for turbidity are in place for this site. It is therefore concerning, although perhaps not unexpected, that *Cryptosporidium* was detected in the final water in November 2016 and January 2017, and disappointing that my Inspectors have had to take enforcement action for something that should be the first objective of a water company, to mitigate risk where risk is identified.

Companies use inhibit timers maintenance switches at treatment works which override the water quality failsafe shutdown systems or alarms and extreme caution should be used when using such systems. While necessary to restart works or routine maintenance, water should always be wholesome when leaving site, something that didn't happen in 2008 at Matts Hill Works (SRN), when repeated overriding of turbidity alarms

resulted in turbid water being sent to consumers as there was no run to waste facility. Ten years later an audit at Sutton Hall works, (UUT), identified 163 uses of the maintenance switch in one year, one every other day. Whilst there is no indication that unwholesome water was supplied during the period reviewed, the absence of procedures controlling overrides indicates learning has not been embedded and a residual, and unnecessary, risk exists.

Regulation 31 sets the requirement for products and substances in contact with water in respect of approval and the conditions of use. This requirement has been in place since 1989 and water companies should be fully compliant. In a series of audits there remain examples where materials are not compliant with the conditions of use, such as the use of 'Seaquest' at South East Water's Arlington works or by Anglian Water at Hall works who were not able to demonstrate that the hydrogen peroxide had been quenched as required. In the latter case, this is a newly designed works which would be expected to be fully compliant with 30 year old regulations. Planning and construction of works must always be planned with water quality compliance as a first priority, after all, as a minimum expectation, water treatment is intended to produce wholesome water.

Regulation 13, (12 in Wales), requires samples to be taken at the point at which water leaves each treatment works. This point is explained in guidance as downstream of final disinfection and any contact period but also should include any chemical dosing for example, pH correction. Any other position would not be reflective of the quality of water leaving a treatment works and would not serve as reassurance of the process. This is not a new requirement, yet instances in two companies have been highlighted in this report where this was not the case. I would urge companies to assess sites where instalments have been in place for a considerable time, to confirm compliance with Regulation 13 (12 in Wales).

The requirement to notify an event has been in place since 1989, the requirements of which are explained most recently in the Water Industry (Suppliers Information) Direction 2017. It was therefore, disappointing that the Inspectorate became aware of an event at Cooks Castle service reservoir, (SRN) in January 2016, three years after the event took place. In this event, a drilling operation at the site caused damage to an outlet main, the ensuing leak caused landslips and joints in the inlet and outlet mains pulled apart leading to ingress into the reservoir and subsequently discoloured and highly turbid water was supplied. Disappointingly, the Principles of Water Supply Hygiene, an industry supported document of best practice, was not followed. This put consumers at an elevated risk as

the minimum requirement in such a situation is that consumers be advised to boil their water.

On one final point concerning long standing expectations covered in this report: this quarter notably saw 30 failures of the lead standard in spite of phosphate dosing and legal instruments in place for a significant proportion of those that have failed. Lead, together with nickel, (which had 10 failures this quarter), have been highlighted in this report a number of times including 2018 Q2 where it was emphasised that both of these parameters have public health implications and occurrence of the metals should be minimised. It is of particular note that the use of lead for water supply has not been approved since 1969, yet action on minimisation does not appear to be a priority even in public buildings. The Inspectorate considered taking enforcement action against Anglian Water for failing to carry out their duties to address a lead exceedance at a physiotherapy centre. This is a public building and drinks were being served to the patients. Equally, enforcement action was initiated against Southern Water after a compliance sample failure for a health-based parameter (nickel) at a public building (a primary school). The school were issued with advice on corrective actions but the company did not require the school operators to remedy the plumbing issues and did not schedule any follow-up inspections. Consequently, the Inspectorate were forced to serve a Notice, requiring the Company to undertake their duty under the Act.

The question arises; what does it take to prompt action to deal with the root cause of lead failures, the presence of lead pipes ? Relying on ongoing phosphate dosing does not address the long term issue. Where a failure has occurred, the minimum response from companies, required by the regulations, is simply confirming phosphate dosing is in place and if requested changing their part of the communication pipe where an owner replaces their part. Looking beyond compliance drives long term strategy and investment to remove risk for future generations, starting in high risk premises such as schools but working towards minimisation and eventually elimination - not to do so ignores a known risk and a social purpose where significant progress has not been significantly forthcoming for fifty years. Will it be fifty years more before the groups most vulnerable in the community are protected? The Inspectorate will continue to challenge companies on the minimisation of lead, through programmes of work, as not to consider this as a business expenditure in future plans is not an appropriate social response.

Surface water audit programme

The third quarter audit programme considered surface water works, focussing on selected critical factors which may increase risk profile in the provision wholesome water if unmitigated. In an extreme circumstance, such shortcomings could give rise to a potential risk to health and should always be treated with the highest priority when considering proactive action. Broadly, these risks can be categorised into technical problems, people problems and system problems. Technical issues include the treatment processes which covers their condition, maintenance, appropriateness for the source water coupled with the monitoring technology and systems in place for critical control points, alarm set points and auto shutdowns. Culture, training and competence were also considered as a key part of the operation to avoid human error, misjudgement or lack of understanding. All of these are held together by process procedures, frameworks and risk analysis such as drinking water safety plans to maintain cohesive alignment of the whole operation.

As is shown by the findings below there are opportunities for improvement in all areas to keep the public protected, together with examples of good practice for wider industry learning.

Drinking Water Safety Plans

Regulation 28 in Wales applies to every treatment works and supply system and requires a company to carry out a risk assessment of each of its treatment works and connected supply systems in order to establish whether there is a significant risk of supplying water that would constitute a potential danger to human health. Examination of reports associated with Dŵr Cymru Welsh Water's Sluvad works were found to be of good quality and contained sufficient detail to identify where the significant risks lay. The control measures sections were coherent, logical and showed what the company was doing to mitigate risks, including any projects or studies being undertaken. The company readily provided evidence of reviewing the works risk assessment following a coliform detection in June 2018, with revised actions to address risks clearly outlined in the reviewed document. The risk assessments identified actions to address a leaking ferric storage tank and to install a run to waste facility at the works to prevent the supply of improperly treated water. The company's plans for delivering these improvements were appropriate, negating the need for any Inspectorate action.

Near Misses and Internal Audit Systems

A key part of process improvement is learning from experience and, as part of this programme, the audit teams examined whether water companies have systems in place to learn from water quality events and near misses, so that risks to health can be avoided.

There is a clear route for Dŵr Cymru Welsh Water's internal audit findings to be reported to the Board and Senior managers, with a clear programme of treatment works audits in place. Sluvad works was audited in May 2018 and previously in 2015. Eleven corrective actions were identified which are tracked to completion on a register. The associated risks are categorised high, medium and low. At the time of the Inspectorate's visit in September, 10 actions were complete with a clear revised date to close out the remaining action.

Independent Regional Managers and Scientists carry out the internal audit programme for South East Water. The actions arising are captured on the Commitments Database and a member of the board reviews progress every two to three months. However, the Inspectorate noted some delay in entering information onto the Commitments Database. It was also unclear how lessons learned from internal audits were appropriately disseminated across the company to prevent similar issues at other sites.

Essex and Suffolk Water's 'Near Miss' reporting system includes Root Cause Analysis workshops and learning is circulated by briefing notes. There are also weekly conference calls and monthly meetings where operational staff and the Water Quality team discuss issues. The Inspectorate welcomed the centralised repository for actions arising, but the system could be improved by associating the action to the severity and likelihood of the risk of the issue it means to address. There were a number of overdue actions, with no clear reason why; and the company's Regulation 28 reports do not show the control measures being delivered. It is unclear, therefore, whether the company's board has true visibility of the water quality risk position.

Thames Water hold a monthly water quality risk review meeting. A risk register lists issues and builds on the investigation. Audits and site walkovers are carried out to inform the Drinking Water Safety Planning process. The Inspectorate observed significant delay in updating the risk management system as updates are only required to take place every three months. The company's risk management system is effectively always out of date. Following a recommendation to improve, the company has committed more resource to ensuring safety plans are updated in a more timely fashion.

Clarification and Filtration

There was a significant algal bloom in the impounding reservoir at Essex and Suffolk Water's Hanningfield works, which was presenting a challenge to the pulsator clarification process. The Inspectors noted significant carryover from the process and increased loading on the rapid gravity filters. The optimisation of the process was hampered by the limitations of online monitoring with one combined turbidity meter and residual coagulant meter providing limited information on the performance of any of the three clarifiers. The clarifiers had tarpaulin covers which limited the ability to observe their performance. Plants were growing in the launders questioning the effectiveness of the covers, but more importantly impairing the ability of the clarifier to operate as designed. The plants are only removed every three years. The Inspectorate recommended the company made improvements to its clarification process.

The poor performance of the clarification process led to increased solids loading and poor performance of the rapid gravity filtration stage at Hanningfield, the algal loading meant that filters were not washing clean and the quality of individual filters could not be determined due to a lack of monitors on the outlet to each. The company were reliant on combined turbidity monitors for each bank of eight filters. This is poor practice and not in line with the recommendations outlined in the Badenoch and Bouchier reports on *Cryptosporidium*. *Cryptosporidium* was detected in the final water in November 2016 and January 2017. Following the audit, the Inspectorate took enforcement action in the form of a Regulation 28 Notice to address the risks associated with *Cryptosporidium*, turbidity and preparing the water for disinfection. Further issues were found at the filtration stage with a risk that the hydraulic fluid could contaminate the supply and, while this is a food grade material, it is not approved under Regulation 31. The hydraulic system operates the filter valves and a failure at this point would prevent the washing of two thirds of the filters. As such, this is a critical point in the works. The company were required to review and update their risk assessment of this process.

Dŵr Cymru Welsh Water were completing a programme of replacing the glass reinforced plastic (GRP) launders on the clarifiers with stainless steel.

Figure 1: Warped GRP Launderers (left), Replaced with Steel at Sluvad works.



During this period, works flows were managed to prevent a deterioration in clarifier performance. A number of dead fish were observed in the rapid gravity filters at Sluvad works and, following a recommendation by the Inspectorate, the company are investigating the installation of low head loss mesh screens in the filter channels to address this risk.

Gaps in the polyelectrolyte dosing records at South East Water's Arlington works left the company unable to demonstrate compliance with Regulation 4. The company reminded operators of this requirement and the procedural requirements are now being followed. The Inspectorate regularly comes across examples of procedures not being followed by employees, for a variety of reasons. It is incumbent upon a company to confirm that its employees and contractors are complying with the policies, procedures and obligations that it has in place to meet its duties under the regulations. The Inspectorate encourages companies to regularly check activities are being completed appropriately to verify that it is complying with its duties under the law.

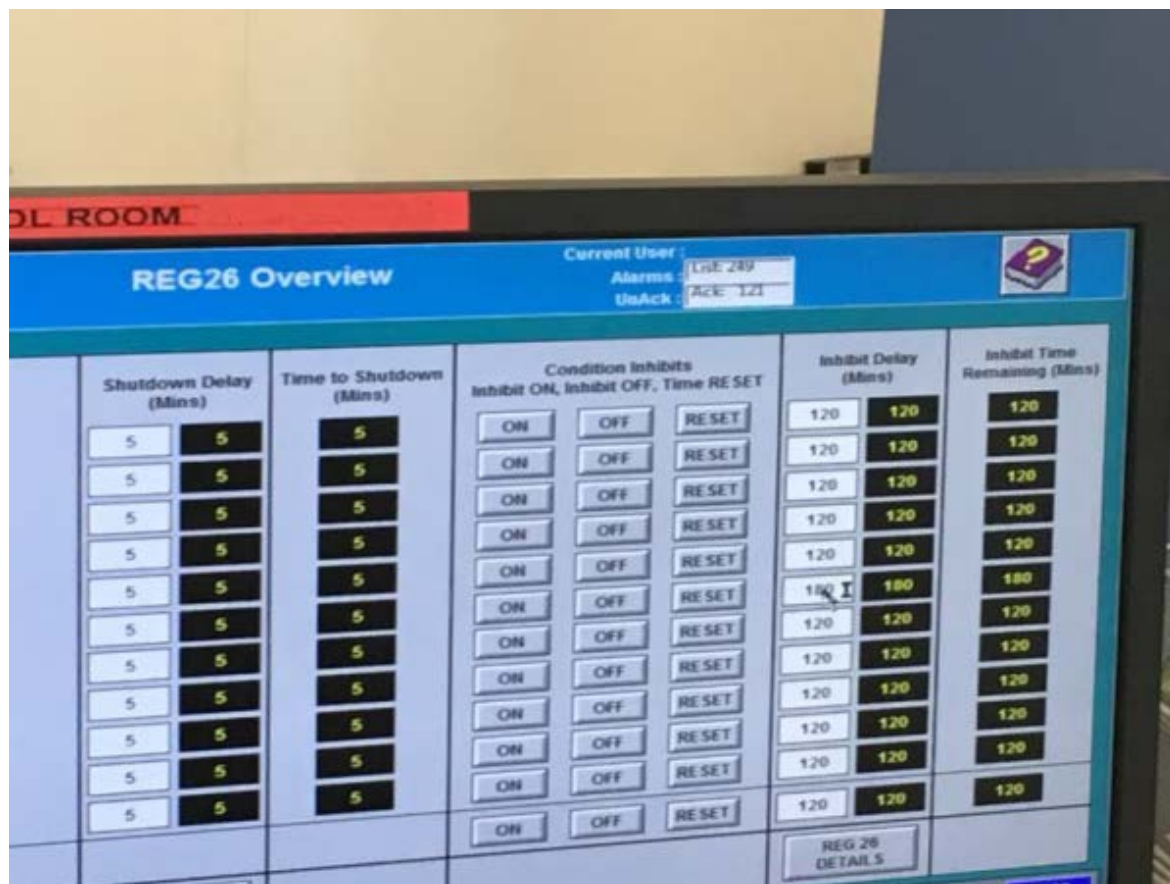
Thames Water had identified that the backwash tanks at Swinford works were overdue for internal inspection, but have not been able to schedule the inspection due to the need for a full works shutdown. This needs to be delayed due to priority being given to internal inspections for service reservoirs that also have not been internally inspected within the last 10 years. This situation shows a lack of appropriate planning and forethought to the internal inspection of service reservoirs and treated water tanks and at least suggests insufficient resources are being committed to this process by the company. Companies are advised to show more diligence in delivering internal inspection and cleaning programmes and to ensure that these are completed upon the basis of risk.

Disinfection

Thames Water's Swinford works can be run to waste after each process stage and has automated shutdowns in place for residual chlorine and turbidity, with a system in place to return improperly treated water to the head of the works.

Conversely, at Essex and Suffolk Water's Hanningfield works, the Inspectorate identified a risk that improperly treated water may not be removed from the treatment process as there were no auto shutdowns in place for turbidity and no scheme in place to run sub optimal water to waste. The company were required to conduct a companywide review of the detection, isolation and, removal of compromised water from treatment streams.

Inhibit timers form part of the alarm operation system at United Utilities' Sutton Hall works. The inhibit timers can effectively override the water quality failsafe shutdown systems at the works and extreme caution should be used when using such systems. It is not appropriate for improperly treated water to be supplied to consumers and Regulation 26 makes specific requirements related to a company's obligations in such circumstances. The company's site specific disinfection policy makes no reference to the conditions when inhibit timers may be used. It was reported that when they are used this would be for a maximum period of two hours. It was observed at the audit that a number of the inhibit timers were set in excess of this limit and these were hastily reset when this was pointed out. There is also no restriction on the number of times the inhibit timers can be reset or an effective upper time limit. This could lead to the wilful or inadvertent override of all water quality safeguards at the works. Whilst it is understood that there may be circumstances when it is necessary to override alarms for a short period, for example during treatment works start up, the use of overrides needs to be scrupulously controlled and their use avoided whenever the water is being supplied to consumers.

Figure 2: Alarm Inhibit Timers at United Utilities' Sutton Hall works

Similarly, the company has in place a 'maintenance switch' which effectively overrides alarms to allow instrument maintenance and calibration to take place. In the 365 days leading up to the audit the switch was used on 163 occasions at Sutton Hall works compared to an average of 7.3 times in the same 12 month period across the other 123 sites with a maintenance switch. This implies a culture of overriding alarms at Sutton Hall, which has neither been identified nor addressed by the company and calls into question the management of this site and independent safeguards the company may have in place to ensure its policies and procedures are adhered to. Following a re-briefing on the procedure for use of the maintenance switch the company reported it had not been necessary to use it at all in the following three month period. United Utilities introduced a new procedure to independently check that maintenance switches and shutdown overrides were being used appropriately.

The disinfection process at Anglian Water's Hall works is subject to a significant chlorine demand from the point of disinfection to the final water. The company did not demonstrate that the cause of the chlorine demand was appropriately understood nor that it had minimised disinfection by-

product formation at this site. To address trihalomethane (THM) formation at site, the company have installed an active ventilation system to agitate the water and vaporise volatile compounds. While this appears to be having a positive effect on THM formation on site, it will not be effective once water leaves the site nor will it have a significant effect on other disinfection by-products such as haloacetic acids.

The air blowers installed at Hall works draw in air from the surrounding rural environment before this is administered to the treated water tank. Anglian Water could not demonstrate that they have appropriately considered the risks of contaminating the process via this route. Agitation of the water is carried out by use of PAX mixers and evidence was not provided at the audit to demonstrate that the mixers complied with the requirements of Regulation 31.

Other Treatment Processes

In line with many other companies South East Water dose orthophosphoric acid to address plumbosolvency issues. It was identified that the company's policy was to respond to dosing shutdowns on the next working day. This means that a dosing failure on a Friday would not be responded to until Monday, which could lead to increased risk to consumers. The company have now changed their practice to respond next day to dosing shutdowns. Companies are advised to review their operating and maintenance strategies for phosphate dosing to ensure the appropriate consistent dose is maintained in light of published research¹

South East Water dose 'Seaquest' at Arlington works. This polyphosphate based chemical is designed to address corrosion and the resulting discolouration issues in the distribution network. The Inspectorate noted that the dosing and chemical storage equipment was close to the road and could be damaged by collision. Furthermore, there was inadequate protection to keep the chemical cool and dry as required by the instructions for use. The company subsequently moved the storage location. Of more concern was that the dose was calculated using average raw water quality data and therefore any short-lived fluctuation in quality was not accounted for. This practice does not comply with the Instructions for Use and hence Regulation 31. The company subsequently reviewed its approach to dosing Seaquest at Arlington works and across all other sites.

Health and safety concerns were preventing operators carrying out drop tests to verify the dose of sodium hydroxide at Arlington works. This has been rectified following a recommendation by the Inspectorate.

¹ Review of the latest evidence on lead and estimation of intake via drinking water. Peter Jarvis, Marjorie Smith and Katie Quy. Cranfield Water Science Institute. <http://dwi.gov.uk/research/completed-research/reports/DWI70-2-277.pdf>

The ozonation process at Arlington works was not operational at the time of the audit and further investigation had identified poor control of the ozonation process since 2017, which South East Water had failed to address. The company had not reviewed the associated risks and had not taken any actions to mitigate for the increased risk of pesticide breakthrough at the works, and repairs to the ozonator were protracted.

Anglian Water's Hall works uses ultrafiltration membranes as part of its treatment stream, these membranes are submerged and although they are situated in a building, the risks of contamination from the surrounding environment had not been appropriately considered as part of the risk assessment for the works.

The next process at Hall works is advanced oxidation (AOP) using hydrogen peroxide and UV to treat difficult to remove pesticides such as clopyralid and metaldehyde. While the process is effective in removing these pesticides it was unclear whether the company had fully considered the other likely impacts of this process including the implications for disinfection by-product pre-cursor formation and the Inspectorate recommended that the company set appropriate inter-stage targets to ensure the water was adequately prepared for disinfection.

Downstream of the AOP process at Hall works are the GAC polishing filters, which are used for taste and odour removal and quenching of any excess hydrogen peroxide from the AOP process. Anglian Water were not able to demonstrate that the hydrogen peroxide had been quenched as required by Regulation 31 or that there were appropriate water quality targets for this treatment stage.

Figure 3: The Advanced Oxidation Process at Anglian Water's Hall works.

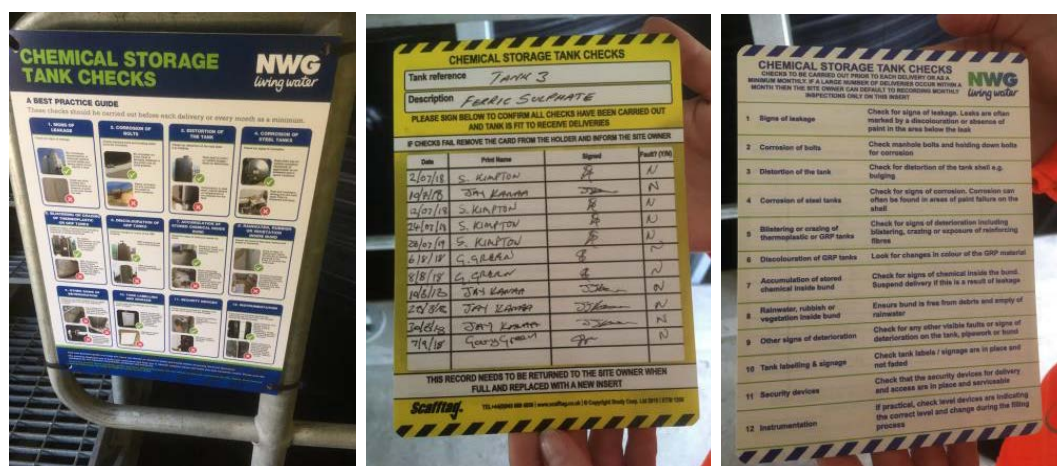


Other Issues of Note

While operators regularly check the operation of sewage pumping stations on site at Thames Water's Swinford works, the condition and status of the sewerage assets was not known at the time of the audit. A subsequent investigation showed a regular failure of both pumps at one of the sewage pumping stations suggesting a blockage of a foul sewer on site. This gives the potential for contamination to occur, directly or indirectly. The company planned further investigations, including a CCTV survey, into the condition of these assets before determining any remedial action necessary. There is no evidence that the risk of sewage contamination from on-site sources has been considered as part of the drinking water safety plan. It has been a regular finding from audits that companies do not always consider potential contamination sources from its own assets and this should serve as a reminder to all companies to ensure contamination risks from sewerage and water fittings are considered as part of treatment works drinking water safety plans.

At Essex and Suffolk Water's Hanningfield works, the Inspectors noted the system of chemical storage tank checks to ensure that the tanks were in good condition and able to accept a chemical delivery, the positioning by the tanks themselves can also be a good prompt to carry out and record the task.

Figure 4: Good Practice. Chemical storage tank checks at Hanningfield works.



Water quality at treatment works

The Inspectorate's assessment of compliance data supplied by companies for the third quarter of 2018 included the reports of 374 compliance breaches and a further 79 samples where the fluoride concentration did not meet the specification required by Public Health England in fluoridated water supply zones. This equates to approximately 40 per cent of fluoride analysis in fluoridated areas.

Review of compliance – microbiological failures at treatment works

Table 5: Q3: 2018 – Microbiological tests

The number of tests performed and the number of tests not meeting the standard

Parameter	Total Number of tests	Number of tests not meeting the standard
Water leaving water treatment works		
<i>E.coli</i>	46,123	2
Coliform bacteria	46,123	12

The revision of the Water Supply (Water Quality) Regulations has led to increased monitoring of treatment works with approximately 7,000 more tests for coliforms and *E.coli* compared to the same period in 2017. There were two *E.coli* failures at treatment works, in the third quarter (BRL 1 and SEW 1). In addition to the *E.coli* failures, there were 12 coliform breaches (SVT 4, SEW 2, AFW 1, BRL 1, DWR 1, TMS 1, WSX 1, and YKS 1).

Bristol Water discovered insects and spiders within the contact tank at Tetbury works following the detection of coliforms and *E.coli* in September. The company's investigation determined that the most probable route for the ingress was via the seals on the access hatch. All seals on all access routes including alarm cable routes were replaced.

Coombe Down works was removed from supply, by South East Water, following the detection of *E.coli* in August. It was identified that the final water sample point was not positioned appropriately as the site specific disinfection policy included the off-site distribution main to the downstream service reservoir as part of the disinfection process. All companies are reminded that the final water sampling point must be downstream of all

treatment processes, including blending where this is used to treat the water to ensure it is wholesome. South East Water's subsequent investigation identified a number of raw water contamination risks including unsealed headworks; contamination pathways between the surface/near-surface and the water table due to the presence of chalk fissures, a soakaway, well shaft and adits and the presence of a nearby septic tank. The works remained out of supply for the rest of the year while remedial work was planned and undertaken.

Of the 12 coliform failures at works in this quarter, four were deemed unlikely to recur by Inspectors following remedial action. Companies failed to determine a cause in four further cases despite a satisfactory investigation. Detections at Severn Trent Water's Mossgate and Church Wilne works shall be addressed by the Notices in place to rectify coliform issues at treatment works. The Inspectorate suggested that critical spares are kept at more readily accessible locations following a PLC fault, which contributed to the coliform failure at South East Water's Bewl Bridge works

Clostridium perfringens can be a useful indicator of either intermittent or historical faecal contamination of a groundwater source. The detection of this organism in a sample from South East Water's Boxalls Lane works identified that the company were not able to fully verify the disinfection process due to the absence of chlorine monitoring equipment at the end of the superchlorination stage prior to dechlorination with sodium bisulphite. The Inspectorate made a recommendation for the company to address this issue and a new monitor was installed. Companies should ensure that they are able to continuously verify that disinfection is achieved at each treatment works and are encouraged to review their disinfection policies and risk assessments to ensure that this can be demonstrated at each treatment works.

Water quality at service reservoirs and in distribution

Assessment of compliance

Table 6: Q3 – Microbiological tests

Parameter	Total Number of tests	Number of tests not meeting the standard
Water leaving service reservoirs		
<i>E.coli</i>	51,226	3
Coliform bacteria	51,226	38

During the third quarter of 2018, there were three *E.coli* failures at service reservoirs (ANH 1, ESK 1, and SRN 1). There were also 38 coliform detections (SVT 8, AFW 3, HDD 3, SWT 3, TMS 3, UUT 3, YKS 3, ESK 2, SEW 2, SRN 2, ANH 1, CAM 1, DWR 1, NNE 1, SBW 1, and WSX 1). This is an increase in the numbers of failures since the second quarter but it represents a notable reduction on the number of failures in the same period in 2017. While we can be hopeful that this indicates an improvement in companies' management of service reservoirs and water towers, by implementing risk based maintenance designed to address structural degradation before it results in microbiological failures; it may be as much to do with the weather and a much drier summer.

There was confusion as to whether a representative sample had been taken from Southern Water's Michelmersh service reservoir after *E.coli* was detected at the site in September. The company were in the process of upgrading the sampling facilities following an *E.coli* failure at the same site in October 2017. Southern Water took steps to isolate the service reservoir from supply, however, it was later established that the outlet valve had not been fully shut and the reservoir remained in supply for three weeks following the detection before it was appropriately isolated. There were several areas of ingress in compartment 2, moreover, tree roots were also found to have penetrated the reservoir in several locations, further compromising the integrity of the reservoir cell. Compartment 1 shall subsequently be inspected once remedial work has been completed. This breach highlights missed opportunities to prevent the supply of unwholesome water. The service reservoir was not internally inspected following the detection of *E.coli* in 2017. The company relied upon internal inspection reports from 2015 rather than carrying out an

internal inspection and the cause of the 2017 failure was attributed to poor sampling facilities. The changeover to the new sampling facilities had not been completed 11 months later when the subsequent breach occurred. The difficulty in closing the outlet valve from the reservoir was also known in 2017 and specialist contractors were engaged at that time to close the valve. The company missed the opportunity to repair the valve in the intervening 11 months leading to the failure to isolate the contaminated tank from supply. Companies are also reminded of the importance of preventing trees and shrubs from damaging the structural integrity of service reservoirs and other structures, particularly those containing fully treated water.

Anglian Water removed Hempstead reservoir from supply following the detection of *E.coli* in September. The site remains out of supply pending structural repairs.

Similarly, compartment 2 of Caister reservoir was removed from supply for the rest of the year after Essex and Suffolk Water detected *E.coli* in August.

Of the 38 coliform failures that occurred in Q3, the Inspectorate was satisfied that the actions taken by water companies meant that 10 of these breaches were unlikely to recur and there were a further nine cases where the company had carried out a satisfactory investigation but determined no cause. This accounts for half of the coliform detections. Another 13 are being addressed by enforcement Notices in place at Hafren Dyfrdwy, Severn Trent Water and United Utilities.

The Inspectorate recommended that South East Water remove Hollingbourne service reservoir from supply for inspection following a coliform detection in July and made the same recommendation to Thames Water when coliforms were found in a sample taken from Hampstead South service reservoir in August. The difficulty in removing service reservoirs from supply has been a long standing issue for the industry and all companies should have by now identified resilience measures to enable any compartment to be removed from supply at short notice should water quality issues make this necessary.

Affinity Water commissioned a new water main to allow further investigations into a long-standing problem at Church Langley Tower. The Inspectorate recommended the company investigate mains integrity risks and disinfection issues associated with the breach. The company identified mobilisation of biofilm as a potential cause and has plans to further treat the bulk imported supply from Anglian Water, to make the water more suitable for movement around its distribution systems.

There were two possible causes identified for the coliform detections at Bournemouth Water's Beaulieu Hill Top Tower in September, biofilm growth or operator error at the supplying treatment works. The Inspectorate made recommendations that the company completes further investigations and takes action to prevent a recurrence in both instances.

In Q3 of 2018, the Inspectorate completed a prosecution in relation to an event at Cooks Castle water service reservoir (WSR) that occurred in January and February 2013. The main delay in bringing forward this prosecution was the failure by Southern Water to notify the event when it occurred, in contravention of the Water Industry (Suppliers Information) Direction. Following investigation of another matter in December 2015, the Inspectorate became aware of the Cooks Castle event and the company submitted an event report in January 2016, three years after the event took place.

An investigation by Southern Water, after the event, concluded that a drilling operation at the site caused damage to an outlet main, the ensuing leak caused landslips and joints in the inlet and outlet mains pulled apart leading to ingress into the reservoir and subsequently discoloured and highly turbid water was supplied. The photograph below shows the quantity of soil that entered the inlet pipe. It was taken by the company while investigating the incident.

Figure 7: Soil ingress in the inlet pipe of Cooks Castle service reservoir.



Sequence of events

Cooks Castle WSR is a 7megalitre (ML) capacity treated water reservoir on the Isle of Wight supplying 17,743 consumers. It has a 450mm outlet to Shanklin and a 300mm outlet to Wroxall,. The site has a known risk of subsidence and Southern Water instructed consulting engineers to conduct an investigation which required drilling two boreholes at the site to monitor ground movement.

A contractor, appointed by the consultants to drill the boreholes, drilled through the outlet main to Shanklin at Cooks Castle WSR without realising. It should be noted that the location of the borehole differed from that originally planned and Southern Water was not notified of the change by the consultants or contractors.

On 24 January 2013 the company telemetry showed evidence of a substantial leak (1ML/d) on the Shanklin outlet main. The company did not adequately investigate this evidence of a leak. This was the first opportunity the company had to prevent the escalation of the event. On 31 January, when the telemetry evidence of a 1 ML/d leak or burst was noticed a leakage team was sent to identify its source but failed to do so. This was a further opportunity to avoid escalation of the event. On 1 February 2013, Southern Water received a report that water was gushing from Cooks Castle WSR. While the company identified a landslip and a leak on the Shanklin main, it failed to isolate the Shanklin main and the flow from the leak(s) continued, thereby exacerbating the risk of further landslips. Despite meetings with contractor and consultant the cause was still not identified. On 6 February 2013 when teams visited the service reservoir, a further landslip was apparent and water was seen cascading from the inlet to Cooks Castle into the fields below. Sampling from the reservoir showed turbidity results of 10.5 NTU in the East cell and 6 NTU in the West cell. The decision was taken to isolate the reservoir, which was completed the same day.

The company conducted flushing in the Wroxall area, supported the supply by tanker and distributed bottled water. Between 6 and 9 February the company received 11 complaints of discoloured water, 76 complaints of interruption to supply (no water) and a further 21 complaints of low pressure were received in the same period. Sixteen samples exceeded the standard for turbidity, the maximum level detected being 48 NTU. Samples that were analysed by a handheld turbidimeter were consistent with these results. In addition nine samples exceeded the standard for iron and two samples exceeded the standard for aluminium.

On 7 February the company took the view that it was 'comfortable with the public health aspect' even though it was aware of 'some ingress of water at Cooks Castle which has caused elevated turbidity in the reservoir' and it

did not issue advice to boil water. Given the sequence of leaks that had occurred at the site, that water was gushing from the area of the inlet main and that the reservoir contained elevated turbidity, it was reasonable to assume that there had been ingress of some amount of soil into the system. The resultant turbid water would have flowed into supply from the reservoir. After isolation of the reservoir there may have been a further supply of turbid water to Wroxall from any soil within the inlet main or gaining access via the break in the inlet main.

The Principles of Water Supply Hygiene states 'Following detection of microbiological contamination in treated water and following suspected ingress of surface water, soil or sewage, customers should, as a minimum, be advised to boil water for drinking'. In this incident, sampling provided no evidence of microbiological contamination, save a single coliform detection that was attributed to a customer tap and chlorine concentrations remained reasonable. Nonetheless, in the circumstances of this event, it would have been good practice for the company to issue boil water advice.

The company could have notified the DWI on 1 February 2013 when there was a significant landslip at the site and associated loss of water. The company should also have notified on 6 February 2013 when it was aware of ingress into the reservoir and elevated turbidity in distribution. The company clearly intended to inform the local health protection unit at that stage and such a notification should also have triggered a notification of DWI. There were numerous other circumstances which should have triggered notification under the Water Industry (Suppliers Information) Direction.

Southern Water pleaded guilty to supplying water unfit for human consumption contrary to Section 70 of the Water Industry Act 1991 at Newport Magistrate's Court on 29 July 2018. The case was referred to Newport Crown Court for sentencing on 10 August 2018 where the company was fined £65,000 and ordered to pay a victim surcharge of £240 and costs of £44,620.99.

Lessons for the industry

There are no new lessons arising from this incident, rather it is a matter of Southern Water failing to follow existing established good practice. The company failed to adequately investigate and isolate the leak though it had a number of opportunities to do so. Despite evidence of probable ingress into its supply system, the company did not issue advice to boil water. The company failed to notify the event to the Inspectorate. Other companies need to be aware of these failures so that they do not make similar

mistakes. The Inspectorate will continue to make a thorough investigation of any event it becomes aware of, whether or not it is formally notified.

Water quality at consumers' taps

***E.coli* 7 (AFW 2, TMS 2, SEW 1, SRN 1, and YKS 1)**

There were seven *E.coli* detections at consumers' taps in the third quarter. The Inspectorate recommended that Thames Water takes further steps to ensure its samplers collect representative samples. The issue relates to attachments on taps in customer properties. These should be removed before tap disinfection and sampling in accordance with EN ISO 19458. While the company took steps to remind staff of the requirement to remove attachments in July and August 2018, the same sampling error occurred in September.

The international standard lays out the requirements for taking representative samples from consumers' properties and compliance with this standard became a regulatory requirement when the Water Supply (Water Quality) Regulations were amended in 2018. Further details of the requirements are outlined in Regulation 9(3) and in the Inspectorate's guidance to the regulations.

Taste and Odour

16 Taste failures, 36 Odour failures

As reported in the second quarter, the discrepancy between the number of taste and odour failures is largely due to water companies choosing not to taste samples where there is an objectionable odour. While in some circumstances there is good reason, for example, when there is a risk to health and consumers have been appropriately informed, in others reasons have not always been apparent. Recommendations related to six odour detections were made for Anglian Water to review its procedure to ensure all compliance samples are tasted when it is safe to do so and sufficient measures are in place to protect those consumers affected when it is unsafe to taste compliance samples.

Recommendations were made that Portsmouth Water should improve the timeliness and scope of its investigations after a pencil shavings/musty odour was detected in Northbrook Supply Zone in July. There were significant delays in establishing the material of the service pipe; limitations in the investigation of the supplying treatment works as a possible cause and a failure to reconsider the risk assessment for taste/ odour as part of the investigation.

The Inspectorate recommended that United Utilities revised its Algal Management Plan for Castle Carrock works in Cumbria after the detection of an earthy taste and odour in the downstream supply zone, in July. The company report that they are planning to trial different types of powdered

activated carbon as a treatment to improve the taste and odour in supplies to the area.

Lead – 30 failures

It is concerning that there were thirty failures of the lead standard in this quarter (UUT 8, TMS 6, SVT 4, AFW 3, ANH 2, WSX 2, DWR 1, ESK 1, and SST 1). This equates to over 1% of all lead compliance sample results taken in the quarter failing the standard with four companies registering higher compliance failure rates than average for this quarter (UUT 1.88%, TMS 1.31%, SVT 1.20%, and AFW 1.83%). A third of the zones where failures occurred have legal instruments in place such that water companies shall improve their compliance with the lead standard by a number of means including targeted replacement of lead communication pipes; optimisation of plumbosolvency treatment processes and working with local authorities and others to ensure the groups most vulnerable in the community are protected.

The Inspectorate considered taking enforcement action against Anglian Water for failing to carry out their duties under section 75 of the Water Industry Act 1991 to address a lead exceedance at a physiotherapy centre. This is a public building and drinks were being served to the patients. The company subsequently reported that the supply pipe was to be replaced in an appropriate timescale. Companies are reminded of their duty in relation to compliance at public buildings and the need to take appropriate action to ensure risks to health and wholesomeness are addressed by those responsible for the public building.

Nickel – 10 failures

There were 10 failures of the nickel standard (ANH 4, UUT 2, YKS 2, SSE 1, and SVT 1). A failure of the nickel standard at a property in Yorkshire Water's Shipley/Bingley 2004 zone, also exceeded the WHO guideline value of 70 µg/l. Appropriate flushing advice was given.

Absorption of nickel from drinking water on an empty stomach is 10- to 40-fold higher than absorption from food and in all ten breaches appropriate flushing advice was given to the consumer, particularly after periods of non-use, such as first thing in the morning. The Inspectorate suggested a change of advice from Anglian Water, who were advising tap replacement. This could potentially lead to a short-term increase in concentrations faced by the consumer. The company's advice was subsequently changed to replacement with a non-chrome/ non-nickel plated WRAS approved tap.

Iron – 32 failures

There were 32 iron failures (ANH 4, DWR 4, SVT 4, TMS 4, UUT 4, YKS 4, NNE 3, SRN 2, SST 2, and SWT 1) with legal instruments in place to address five in areas served by Dŵr Cymru Welsh Water, Southern Water and United Utilities.

The Inspectorate is taking further enforcement action to reduce the risk of iron failures across a number of Southern Water zones, including the Wigmore zone, where a sample exceedance was recorded in this quarter.

Flushing had proved ineffective in addressing elevated iron results in Anglian Water's Buckingham zone and the Inspectorate recommended that the company develop a more detailed plan to address this localised issue. A recommendation was made that the company regularly verifies the residual iron readings from the online monitor at Saltersford works, to give confidence in the treatment works performance following a breach in the Barrowby zone.

Manganese – 6 failures

The six manganese exceedances occurred across three companies (DWR 2, SVT 2, and UUT 2). The majority (four) were ascribed to elevated flows during the hot weather and while the companies took short term measures such as flushing to prevent a recurrence, further work may be required in these zones to prevent future failures. Both failures in Dŵr Cymru Welsh Water's region occurred in the Abergavenny/ Cwmtillery zone, while a second breach in 2018 occurred in United Utilities Gorsehill water supply zone. Further scrutiny is likely should further failures occur in these areas.

Benzo(a)pyrene

Severn Trent Water were unable to identify a cause for the presence of Benzo(a)pyrene in a sample from its Barlborough zone. This substance is known to be associated with coal tar lined mains. The company were slow to investigate the failure and have been unable to find any coal tar lined mains in the supply to the property. However, the company have taken reasonable steps, including mains cut outs, to determine the cause and widened the scope of their investigation to the whole district metered area (DMA) to seek a cause.

Total Trihalomethanes

The Inspectorate is serving a Notice under Regulation 28 on South Staffs Water after four samples exceeded the standard for Total Trihalomethanes across its West Bromwich, Walsall and Barr Beacon 1 water supply zones in September. The company use prechlorination to control algal issues and improve the clarification process at Hampton Loade works, which supplies

the area. The company relied upon analytical results from its works to manage compliance, but when the contract laboratory were unable to provide timely results due to a problem with the analytical method this control measure was rendered ineffective. The company did not take sufficient action to reconsider the risk to compliance and health resulting from this change in circumstances and the regulatory standard was breached. The Notice shall address issues with regard to taste and odour (as reported in Q2), trihalomethanes and disinfection by product precursors. Companies need to remain vigilant to changing circumstances which could compromise the control measures it has in place and be able to dynamically review the altered level of risk, so that public health is protected.

Legal Instruments

PR19 submissions

During the quarter, the Inspectorate started to receive populated templates for the AMP7 Regulation 28(4) Notices. These are being assessed by Inspectors and will then be formally issued.

New Legal Instruments Issued

In the third quarter of 2018, the Inspectorate served 29 new legal instruments;

- Notice under Regulation 28(4)– PRT 7, SEW 1, SRN 1, TMS 13 and UUT 1
- Notice under Regulation 27(4)– SRN 2, TMS 1 and UUT 1
- Notice under Regulation 21(3)– SRN 1
- Enforcement Order (Section 18 of the Water Industry Act) – SRN 1

The Inspectorate initiated enforcement action against Southern Water after a compliance sample failure for a health-based parameter (nickel) at a public building (a primary school). The school were issued with advice on corrective actions to take, however the company did not issue a Section 75 Notice compelling the school operators to remedy the plumbing issues and did not schedule any follow-up inspections. Consequently, the Inspectorate served a Regulation 21(3) Notice, requiring the Company to use their powers under Section 75 of the Water Industry Act 1991. The Company served the required Section 75 Notice and undertook a repeat inspection to verify the deficiencies with the plumbing had been corrected.

The Final Enforcement Order (FEO) served on Southern Water was as a result of a successful change application to alter the technical solution of an existing FEO for Shoreham Water Treatment Works. The original FEO solution was to install a nitrate removal plant to mitigate predicted future increases in nitrate concentrations. The Company have demonstrated that improvements to connectivity and monitoring in the network were able to deliver blending options. The Company will also be putting in place measures to enable the works to be shut down for short durations during low water demand periods. This was considered a more sustainable option overall and therefore the change application was accepted and a new FEO was issued.

The seven Notices served on Portsmouth Water this quarter were driven by the company's deficiencies with post disinfection verification (Regulation 26(2)(b)), together with inadequacies in the company's disinfection policy. The Notices are targeted at delivering disinfection improvements at the corresponding water treatment works. Initially there was also a concern that some of the company's compliance monitoring points were incorrectly located before the end of the disinfection process. Companies are reminded that the regulatory compliance point for treatment works is after disinfection has been completed as per the Guidance for Regulation 13.

Thames Water transformation programme

This quarter saw a large number of legal instruments issued to Thames Water. The 14 Notices issued to Thames Water are the first tranche of a suite of Notices served as part of the company's transformation programme.

The Inspectorate has been working collaboratively with the company since the beginning of the year to formulate a package of Notices which are aimed at transforming the water quality performance of the company and reducing the level of risk. The package of Notices underpin five key work streams that have been identified to carry significant risk within the company. These five areas are for risk or deficiencies associated with:

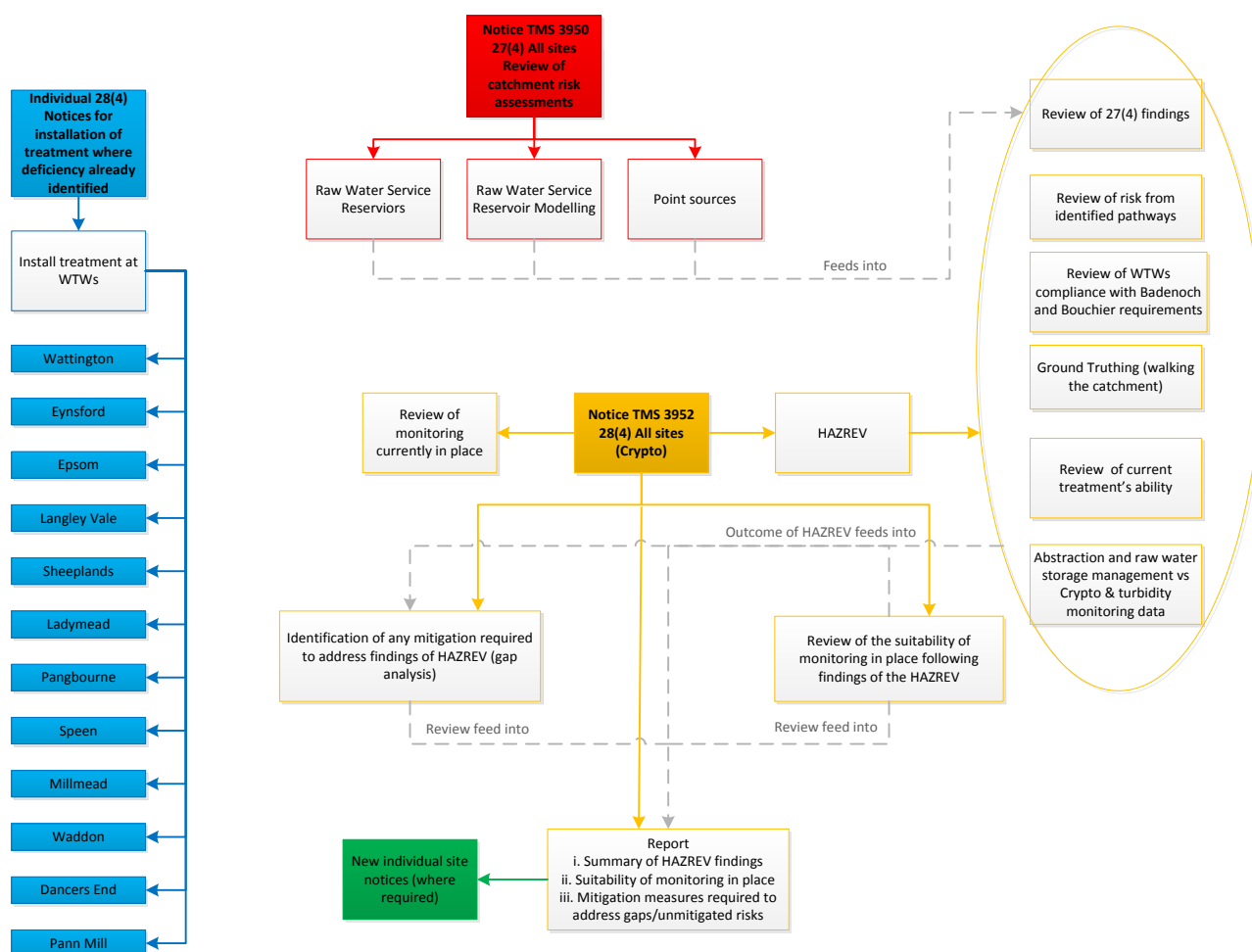
- Risk assessment and treatment of *Cryptosporidium*
- Management of turbidity
- Management of slow sand filters
- Management and Competency (training and culture)
- Risk from flooding

The Thames Water transformation programme has similarities to the Southern Water transformation programme which was reported in the last quarter. Although the Southern Water programme was initiated a short while before the Thames Water programme and the identified risks are individual to each company, there are also similarities in the general themes that these risk fall under. As a result, cross-learning has been shared between the two programmes to enable the most effective programmes to be delivered and to ensure a consistent approach to enforcement by the Inspectorate.

Risk assessment and treatment of *Cryptosporidium*

The 14 Notices served this quarter related to *Cryptosporidium*. This included a Regulation 27(4) Notice, and 13 Regulation 28(4) Notices, one for all sites and 12 for installation of treatment at individual sites (see Figure 8).

Figure 8: Overview of the *Cryptosporidium* work stream of the Thames Water transformation programme.



The Regulation 27(4) Notice was served for the review of the company's *Cryptosporidium* catchment risk assessments at all sites following the identification of deficiencies. The risk assessment review includes; a review of the contamination risk from raw water storage reservoir; raw water storage modelling assessment; and a review of the risk posed by *Cryptosporidium* point sources around abstraction points and within

catchments. The updated risk assessments completed under the Regulation 27(4) Notice will, in turn, feed into the mitigation measures required under the company's *Cryptosporidium*, 'all sites' Regulation 28(4) Notice, which was also served this quarter.

The *Cryptosporidium*, 'all sites' Regulation 28(4) Notice includes (among other things) an in-depth hazard review (Hazrev) to identify all aspects that could constitute a risk to water quality and public health from *Cryptosporidium*. The Hazrev includes specific elements (see Figure 8) to address gaps that were identified with the company's control of the risk from *Cryptosporidium* within their catchments, raw storage management and at their water treatment works.

Following the completion of the Hazrev at each water treatment works, a review of the suitability of the monitoring in place and a gap analysis between the identified risks and the treatment capability, will take place. Where unmitigated risks are identified, this will result in the creation of new individual legal instruments for these sites. The Notice has been deliberately set-up in this way to branch-off into new Notices (as required) to address previous issues where large 'all sites' remediation Notices were unable to be closed following particular difficulties at one or two of the sites covered by the Notice.

Running alongside the 'all sites' Regulation 27(4) and 28(4) Notices are 12 individual Notices for the installation of treatment at water treatment works where an unmitigated or partially unmitigated risk from *Cryptosporidium* has already been identified.

Closures

The Inspectorate received eight closure reports in the third quarter of 2018 (AFW 1, DWR 1, ANH 1, SRN 1, SVT 2, UUT 1 and WSX 1).

Change Applications

The Inspectorate received ten change applications during the third quarter of 2018 (ANH 1, PRT 6, SBW 2 and SRN 1).

The seemingly disproportionately large number of change applications submitted by Portsmouth Water this quarter related to a variation of a single reporting date replicated in six of their disinfection Notices which had been issued earlier in this quarter (see above under New Legal Instruments Issued).

Milestones

There were 46 milestone reports (independent of closure reports) submitted to the Inspectorate during the third quarter of 2018. The large number of milestone reports submitted by Southern Water are associated with the transformation programme schemes, which were described in the previous quarterly report.

Table 9: Milestone reports received during Q3 of 2018

Company	Milestones Reports	Company	Milestones Reports
DWR	6	SWT	4
NNE	1	TMS	4
PRT	7	UUT	4
SEW	1	WSX	1
SRN	17	YKS	1

Regulation 15 – sampling: new sources

During the third quarter of 2018 the Inspectorate received 12 applications under Regulation 15 (CAM 1, SRN 2, SST 1, SVT 1, SWT 4, TMS 1, UUT 2). The long, hot summer caused water resource difficulties in some regions of England, requiring companies to bring new sources into supply, or return some sources to supply which have not been used for over six months. In response, the Inspectorate prioritised all such applications. In the majority of cases, the Inspectorate were able to respond within two days. It was of concern that many of the companies were not able to demonstrate longer term planning for drought and increased demand and the Inspectorate will continue to examine and challenge the companies' approaches to source reintroduction in response to increased demand and potential for drought in the coming months.

Radioactivity waivers

During the third quarter of 2018, the Inspectorate received three applications to cease regulatory monitoring for radioactivity parameters under Regulation 6 (CAM 1, SSE 2).

DWI as WHO collaborating centre

The Drinking Water Inspectorate has been designated a World Health Organisation Collaborating Centre for Drinking-water Safety since January 2010. DWI are committed to a work plan which includes 10 core activities. During quarter three of 2018, four members of the DWI contributed to one of these activities; 'Water Safety Plan (WSP) Capacity Building', by visiting countries that have sought help from the WHO Regional Office for Europe. Additionally, the DWI are part of the review team for the revision of the Water Safety Planning Manual, and represent the UK on the expert group responsible for preparing the guidance document 'Risk-based approaches towards strengthening drinking water quality surveillance'.

The first capacity building event was held in Vilnius, Lithuania. Lithuania is at the very start of implementing Water Safety Planning, therefore the capacity building was at an introductory level and delivered to a variety of personnel. DWI presented on experience with implementing Water Safety Planning, including real examples of hazard identification and risk assessment, and our small water supplies risk assessment tool.

The second event was tailored for policy makers in Belgrade, Serbia. The Inspectorate's contribution was to describe the benefits of implementing WSPs, and what support mechanisms are required for successful implementation.

The third event was to 'Train the Trainers' in Zagreb, Croatia. The small group of trainers were members of the Croatian Institute of Public Health and Ministry of Health. WSPs are to be adopted into national legislation, replacing the Hazard and Critical Control Point (HACCP) approach currently in place. The capacity building focussed on the differences between HACCP and Water Safety Planning, and what changes would be required to legislation and working practices, in order to convert from one to the other. The trainers would be tasked with further disseminating the knowledge and information gained at the event.

The final event was in Rome, Italy, and was again, 'Training the Trainers'. The large group of delegates had a mixed level of knowledge about WSPs, some being quite experienced. This reflected the varied status of WSP implementation across the country. DWI again shared experience with implementation, in particular, the practicalities for the different parties involved and our approach to WSPs for small supplies.

The DWI is pleased to support the WHO, and to continue making a positive contribution towards water safety on a global level.