

SUMMARY OF EVENTS AND INCIDENTS 2016

Scottish Water is required to tell the Drinking Water Quality Regulator for Scotland (DWQR) about events that could affect water quality. DWQR assesses all events and categorises them in consideration of their impact on public confidence in the water supply. There are five categories used with the three most severe declared by DWQR to be incidents.

Category	Not Significant	Minor	Significant	Serious	Major
No. of Events	658	114	19	5	2

The following tables detail the significant, serious and major events declared as incidents. Each individual incident assessment can be viewed on the DWQR website: <http://dwqr.scot/regulator-activity/water-quality-incidents/2016-incidents/>

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Event Date, Duration & Classification	Area	Estimate of population affected	Nature and cause of the event	Main actions and findings from the DWQR investigation
5 Jan 2016 For 3 days Classification: Significant	Kyle of Lochalsh zone, Highland, North Region	2,544	Treatment failure – ammonium	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by a faulty chlorine monitor drifting out of calibration. The resultant overdosing of chlorine led to a subsequent overdosing of ammonia to maintain the chloramination ratio; • Scottish water staff acted quickly and appropriately when they received notification of the ammonia alarm; • However, the faulty probe had continued in use for almost a month prior to the incident and the lack of urgency in resolving this issue indicates poor awareness of the significance of such monitors; • The alarm settings were set very close to the permitted limit for ammonia, giving Control Centre staff and site operators very little time to correct any problems with ammonium dosing; • This incident occurred only two months after another incident at the same site due to a similar issue; • Recommended applying “Verified - Do Not Defer” alarm priorities to telemetry and updating telemetry asset notes to reflect feedback received associated with single point of failure chloramination alarms. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Adopted reduced Early Action Levels and programme alarms on the ammonia monitor; • Trained staff on correct operation of the ammonium dosing apparatus and on calibration of chlorine probes; • Added ‘Do not defer’ alarm priorities to final water ammonia monitor on telemetry; • Reinforced procedures and options available when calibrating chlorine probes; • Updated the frequency of cleaning and maintenance of the ammonia monitor to improve repeatability and signal consistency; • Tested the water quality digital alarms at the treatment works; • Investigated the low frequency of ammonia monitor updates on telemetry.

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Jan to Apr 2016 For 3 months Classification: Significant	Killylour WTW, Dumfries & Galloway, South Region	26,820	Repeated detections of <i>Cryptosporidium</i>	DWQR comments and findings: <ul style="list-style-type: none"> This incident and a number of associated events were caused by the inability of the treatment process at Killylour works to remove <i>Cryptosporidium</i>; DWQR considers that the Scottish Water's response to these events was appropriate; There have been no further detections of <i>Cryptosporidium</i> oocysts since the new membrane treatment process became operational. Scottish Water actions: <ul style="list-style-type: none"> Reduced the flow of water through the treatment works as far as possible and increased the contributions from other supplies as an interim measure; Increased the frequency of <i>Cryptosporidium</i> monitoring at the treatment works in response to the increased risk; Installed a new membrane treatment process at the treatment works.
8 Feb 2016 For around 7 days Classification: Significant	Loch Calder WTW, Highland, North Region	26,636	Treatment failure – ammonium	DWQR comments and findings: <ul style="list-style-type: none"> The incident was caused by a fault with the pump dosing ammonia which resulted in ammonia being overdosed. This problem went unnoticed because the ammonium monitor was offline at the time due to a separate fault; It is unsatisfactory that, despite an awareness of the dosing pump problem and the offline status of the ammonium monitor, ammonium sulphate dosing pump calibration tests and bench tests for ammonium were only being carried out on a weekly basis; Recommended producing a Scotland-wide procedure to increase bench testing while ammonium monitoring is offline. Scottish Water actions: <ul style="list-style-type: none"> Identified the fault and repaired the ammonium monitor; Reviewed monitoring requirements and calibration record-keeping; Reviewed and optimised the dosing pump settings and the maintenance schedule for the dosing pumps; Increased the frequency of dose drop tests and residual bench tests; Reviewed the overall ammonia dosing and chloramination control process and identified improvements where appropriate.

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Jan to Apr 2016 For 3 months Classification: Significant	Tullich WTW, Argyll, North Region	12,340	Repeated detections of <i>Cryptosporidium</i>	DWQR comments and findings: <ul style="list-style-type: none"> This incident and a number of associated events were caused by the inability of the treatment process at Tullich WTW to remove <i>Cryptosporidium</i>; A capital project to deliver an approved cryptosporidium barrier process will be completed by September 2017. Scottish Water actions: <ul style="list-style-type: none"> Increased the frequency of sampling for <i>Cryptosporidium</i> at the treatment works; Checked and corrected where necessary the operations of the filters; Increased the frequency of filter backwashing; Implemented weekly catchment inspections to identify any significant risks due to animal faecal matter entering the raw water source for Tullich WTW; Repaired a fence to prevent livestock access to the source; Installed a UV disinfection process to inactivate any <i>Cryptosporidium</i> oocysts present in the final water leaving the treatment works.
20 May 2016 For 7 days Classification: Significant	Camisky WTW, Highland, North Region	13,580	Treatment failure – ammonium	DWQR comments and findings: <ul style="list-style-type: none"> The incident was caused by a faulty probe on a chlorine monitor which produced high readings causing the ammonium dose to be increased; Furthermore, the high chlorine alarm was deferred because it was assumed that there was a fault with the chlorine monitor; It is disappointing that Control Centre staff were unaware that the post chlorine contact tank monitor controlled ammonium dosing; Recommended applying “verified – do not defer” alarm priorities to telemetry and updating telemetry asset notes to reflect feedback received associated with single point of failure chloramination alarms; Recommended reviewing the Drinking Water Safety Plan in the light of the root cause identified during this incident. Scottish Water actions: <ul style="list-style-type: none"> Replaced the faulty chlorine monitor probe and recalibrated the instrument; Added a ‘do not defer’ tag to the chlorine monitor alarm; Replaced the ammonium monitor sensor head.

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14 Jun 2016 For 10 days Classification: Significant	Badachro WTW, Highland, North Region	176	Treatment failure – pH	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by a treated water pH monitor drifting out of calibration which allowed water having an increased pH to enter the supply; • It was further aggravated by operator failure to use a handheld pH monitor correctly and failure to verify the pH by checking the final water pH monitor; • Recommended ensuring correct and clear labelling of all monitors and sample streams throughout the treatment works; • Recommended developing and implementing site-specific procedures for altering the pH using the pH adjustment vessel; • Recommended reviewing training needs in relation to using the site diary to record activities not recorded on task scheduling. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Connected the final water pH and turbidity monitors to telemetry and configured alarms for these; • Reviewed operator training needs in relation to pH monitoring of sample streams.
25 Jun 2016 For 4 days Classification: Significant	Stoneybridge (South Uist) WTW, Western Isles, North Region	1,568	Treatment failure – colour and iron	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by the separation of the coagulant dosing line from the injection point. Reattachment of the line resulted in normal operation; • The dosing lines were not checked following the coagulation failure as it was wrongly assumed that a change in raw water quality was to blame; • This assumption led to unnecessary remedial actions, including draining the clear water tanks and scouring the network, which caused colour and iron failures at consumers' taps; • While no microbiological failures occurred, the compromised chlorine dosing led to inadequately disinfected water entering the network. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Provided refresher training for the stand-by operator; • Provided root cause analysis training for all South Uist operators, particularly in relation to coagulation faults; • Reviewed procedures relating to the response to low flow of coagulant and visual inspection of coagulation.

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From Mar 2016 Classification: Major	Aviemore zone, Highland, North Region	10,542	Taste and skin irritation complaints and consumer concern regarding the water supplied from Aviemore WTW	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was declared in response to increased consumer concerns over the water supplied from Aviemore WTW and chloramination of the supply; • DWQR investigations found the water treatment process at Aviemore WTW to be extremely robust, well operated and fit for purpose; • The water supplied by the treatment works was fully compliant with regulatory parameters throughout the duration of the event; • Chlorine levels at the treatment works and throughout distribution are within normal limits; • As with all treatment processes, DWQR expect Scottish Water to carefully monitor and manage the introduction of chloramination to the supply and to continue to address the concerns of the local population during this process; • DWQR will closely monitor water quality and consumer concerns in the Aviemore distribution area during and after the introduction of chloramination. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Discussed consumer concerns with NHS Highland; • Held drop-in public information sessions throughout Badenoch & Strathspey; • Met with the local area MP, councillors and action group to discuss concerns.
5 Jul 2016 For 15 hours Classification: Significant	Mannofield WTW, Aberdeenshire, East Region	286,588	Treatment failure - loss of disinfection	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident resulted from a low pressure in the service water system which caused failure of the service water pumps due to control settings for a low pressure alarm; • Because Scottish Water took appropriate actions, a satisfactory chlorine concentration was present at all times in the final water leaving the works; • Recommended reviewing priority assigned to low chlorine alarms at entry to all chlorine contact tanks to allow early warning of disinfection process issues. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Investigated whether a reduction in the efficiency of the service water pumps contributed to the low pressure; • Investigated and corrected alarm and associated telemetry failures; • Investigated, reviewed and modified where necessary service water pump control settings.

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<p>8 Aug 2016</p> <p>For 7 days</p> <p>Classification: Major</p>	<p>Muirdykes zone and the Royal Alexandra Hospital, Renfrewshire, West Region</p>	<p>67,525</p>	<p>Treatment and management failures - manganese and discolouration</p>	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by a combination of inadequate removal of manganese at Muirdykes WTW and a failure to clean a water storage tank at the Royal Alexandra Hospital (RAH); • This incident followed a number of manganese failures at Muirdykes WTW and within the Muirdykes distribution system; • Recommended that Scottish Water, Licensed Providers and all Scottish Health Boards work together to produce tailored, effective emergency plans for all hospital sites; • Recommended that Scottish Water proactively review emergency plans when further interventions, such as undertakings/enforcement action, are imposed; • Recommended that Health Facilities Scotland facilitate effective communication and understanding links between NHS health boards, the Licensed Provider and Scottish Water to share knowledge and best practice. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Cleaned and flushed the affected on-site water storage tank; • Commissioned on site treatment to remove manganese at RAH; • Produced and rolled out a procedure for Licensed Provider contact regarding water quality issues at hospitals and prisons; • Reviewed operational management plan and maintenance records for RAH system including storage tanks, flushing and network maintenance with RAH; • Reviewed the Muirdykes Zonal Action Plan, prioritising the RAH supply zone; • Provided training to RAH personnel in valve operations; • Reviewed and updated the Drinking Water Safety Plan in the light of the root causes and conclusions relating to this incident.

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<p>12 Jul 2016</p> <p>For more than 7 days</p> <p>Classification: Significant</p>	<p>Balmore E zone, West Lothian, South Region</p>	<p>36</p>	<p>Discolouration and odour due to contamination of water by polycyclic aromatic hydrocarbons (PAH)</p>	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by a failure to flush away PAH (released from historic coal tar-lined mains) which had collected up against a closed valve used for a backfeed prior to this valve being opened to supply customers following a water main burst; • It was not possible to flush the PAH-contaminated water away before opening the valve due to a lack of suitable infrastructure; • However, Scottish Water should have been alert to the possibility of quality deterioration and monitored quality downstream as the valve was opened; • Scottish Water's subsequent flushing actions were appropriate but it is unacceptable that no quantitative PAH analysis was undertaken on samples until more than seven days after the incident commenced; • Recommended reviewing the adequacy of Scottish Water's approach to the assessment and implementation of facilities to allow flushing against closed strategic valves prior to their opening; • Recommended developing and disseminating an internal process to ensure appropriate timely samples are taken in response to water quality incidents. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Flushed the system gently over time to remove traces of PAH; • Installed hydrants either side of the valve to enable flushing prior to opening the valve.

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<p>18 Jul 2016</p> <p>For 1 day</p> <p>Classification: Significant</p>	<p>Milngavie C2 zone, Glasgow and South Lanarkshire, West Region</p>	<p>1,100</p>	<p>Sampling procedure failure – microbiology</p>	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was probably caused by a sampler using an incorrect procedure for sampling due to being incorrectly trained; • No regulatory or health-based standard was breached; • Scottish Water reacted rapidly to a perceived significant microbiological failure in a large office building and provided bottled water to staff in the building. • Prompt and thorough investigation of the sample failure minimised the duration of the boil notice and the inconvenience to consumers; • This incident highlights the crucial role of sampling staff and the importance of their training in sampling procedures. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Retrained the sampler involved in the incident; • Identified staff trained by the same trainer and developed a plan to ensure any required training was carried out; • Ensured all demand team samplers were appropriately trained; • Reviewed the trainers' training to ensure all were adequately trained; • Revised sampling procedures and established a process for dealing with non-regulatory large volume sample failures.

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<p>22 Jul 2016</p> <p>For 1 day</p> <p>Classification: Significant</p>	<p>Balquhiddy WTW, Stirling, West Region</p>	<p>162</p>	<p>Storage point failure – manganese and iron</p>	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused Scottish Water’s failure to recognise that the treatment works was not in service and disturbance of sediment in the clear water tank by the consequent tankering operation; • Recommended that Scottish Water’s West area compile and manage a risk based tank cleaning schedule; • Recommended Scottish Water determine the estimated storage time in the Balquhiddy clear water tank and update all records accordingly; • Recommended Scottish Water review the implementation of impact assessments during tankering operations, and where appropriate carry out procedural changes and staff training; • Recommended Scottish Water review and implement sampling response during water quality incidents. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Cleaned and inspected the Balquhiddy clear water tanks and repaired the tank valves; • Reviewed the escalation process within the Treatment Team to ensure the Senior operator and team leader are notified of comms failures; • Investigated why the telemetry from the works froze and needed to be reset; • Included ‘do not defer’ status on the radio system fail alarm on the telemetry; • Included an asset note on telemetry regarding the purpose of the alarm and the associated implications; • Briefed Operations and Control Centre staff on the significance of the radio comms alarm condition; • Reviewed the Investigative Samples Guidance to ensure that consideration is given to chemical sampling when tankering; • Ensured the Public Health Team were made aware that additional chemical sampling should be considered during tankering activities.

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16 Aug 2016 For 19 hours Classification: Significant	Kirbister WTW, Orkney Islands, East Region	11,973	Treatment failure – aluminium	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> The incident was caused by a failure of the coagulation process due to a blockage in the polyelectrolyte dosing system. A calibration issue with the aluminium sulphate dosing pump caused a subsequent elongation of the process recovery period; A more fundamental inspection of the chemical dosing systems would have identified the polyelectrolyte dosing pump filter blockage as the root cause; Recommended reviewing operator guidance on identifying problems in chemical dosing systems; Recommended providing confirmation of the expected delivery date for the upgrade to the polyelectrolyte dosing system. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> Replaced the aluminium sulphate dosing pump; Improved polyelectrolyte mixing at the dissolved air flotation outlet; A dissolved organic carbon analyser will be installed at the treatment works.
28 Aug 2016 For 7 days Classification: Serious	Corsehouse zone, Ayrshire, West Region	9,148	Algal bloom – taste and odour	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> The incident was caused by decomposing algae producing a substance called geosmin in raw water entering the Corsehouse treatment works; There is no treatment process to remove geosmin; There was good co-ordination between Scottish Water departments and decisions to shut down the raw water supply were swift and effective; Recommended Scottish Water's procedure for introducing new raw water supplies or those not used for six months or longer includes a requirement to sample the source in accordance with regulation 14 of the Public Water Supplies (Scotland) Regulations 2014; Recommended reviewing sampling requirements for raw water sources considered to be at risk from algal blooms and updating procedures as appropriate. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> Revised the procedure for introduction of additional or alternative raw water sources into water treatment works and rolled this out to Operations Teams; Reviewed whether the test suite for algae should include geosmin.

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14 Sep 2016 For 7 days Classification: Serious	North Hoy WTW, Orkney Islands, East Region	46	Sampling procedure failure – microbiology	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The cause of the failing samples which prompted this incident remains unknown as there was no confirmation available as to where the samples were taken; • The samples were found to be unrepresentative of the quality of the waters at the sampling locations recorded; • There were no system or business process failures, rather, wilful individual misrepresentation of facts and falsification of records; • DWQR is satisfied that Scottish Water carried out appropriate investigations to establish the cause of the sample failures; • Recommended reinforcing requirements to personnel for sampling to be carried out in accordance with Drinking Water Quality Regulations. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Improved plant housekeeping including cleaning of analyser probes, removal of rubbish and making sure sample bottles are available to the operator; • Investigated shelter options for the Graemsay final sample tap; • Sheltered the North Hoy final sample tap from the plant surroundings.

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Sep 2016 For 17 days Classification: Serious	Balmore Carron Valley zone, Lanarkshire, South Region	3,128	Storage point failure - microbiology	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by a number of factors including low chlorine residuals due to high residence times within the distribution network as well as possible integrity issues at the main tank supplying the zone or possible microbiological issues in the water leaving Carron Valley WTW; • Recommended verifying that the disinfection process at Carron Valley WTW is operating in accordance with internal standards and water industry best practice; • Recommended producing and maintaining a management plan to ensure on-going microbiology management within the Balmore Carron Valley regulatory supply zone. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Carried out structural repairs to a water storage tank, confirmed the schedule for cleaning the associated water supply zone; • Cleaned and inspected clear water tanks at Carron Valley WTW; • Considered whether further guidance was required to assess lower than average chlorine levels in water supply zones; • Reviewed the process for assessing flow cytometry information from service reservoirs.

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21 Sep 2016 For 11 days Classification: Serious	Sanday WTW, Orkney Islands, East Region	478	Treatment failure – aluminium and turbidity	DWQR comments and findings: <ul style="list-style-type: none"> • The incident was caused a failure to respond to changes in raw water quality combined with the poor performance of the Dissolved Air Flotation (DAF) unit due to low levels of air saturation; • Recommended establishing system of monitoring efficiency of air saturation to ensure optimal operation of DAF plant; Scottish Water actions: <ul style="list-style-type: none"> • Inspected and serviced the aluminium monitor; • Investigated whether pre-coagulation pH control and dosing was required; • Added the signal from the raw water turbidity monitor to telemetry; • Investigated works' automatic ramp down to minimum flows on high turbidity; • Optimised aluminium sulphate dosing; • Delivered training support on bench testing to site operators; • Reviewed the Failure Response Strategy for coagulation events; • Reviewed procedures for reporting to the Public Health Team and for reporting PCV (prescribed concentration or value) contraventions with the Operations Team.

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17 Oct 2016 For 7 hours Classification: Significant	South Moorhouse WTW, Glasgow / East Renfrewshire, West Region	29,662	Treatment failure – pH	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by an operator placing pH dosing on manual while a pump was being replaced and then failing to change the pH dosing back to automatic once the repair had been carried out; • No samples were taken in the distribution system as a result of this incident so the pH of the supply at consumers' taps was not assessed; • Scottish Water needs to develop a system to ensure that operators are reminded that they have switched automatic systems to manual; • The alarm setting for final water pH did not allow sufficient time for a response before the pH exceeded the PCV (prescribed concentration or value) so it is crucial that Scottish Water reviews alarm settings; • Recommended reviewing the process employed when changing the status of equipment from automatic or flow proportional to manual at Scottish Water assets across Scotland in addition to South Moorhouse WTW. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Reviewed the process used when changing the status of equipment from automatic or flow proportional to manual; • Carried out a review to determine the appropriate action to prevent this from re-occurring; • Reviewed the level at which the treated water pH alarms are initiated and the associated Emergency Action Levels; • Reviewed the naming convention used for the telemetry alarms at South Moorhouse to provide a clearer understanding of these within the Scottish Water Control Centre.

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<p>8 Nov 2016</p> <p>For 2 days</p> <p>Classification: Significant</p>	<p>Forehill WTW, Aberdeenshire, East Region</p>	<p>24,422</p>	<p>Treatment failure – <i>Cryptosporidium</i></p>	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by the failure of the ferric sulphate dosing system which led to the breakdown of the coagulation process. • Recommended ensuring the pre-chlorine contact tank is correctly scaled on telemetry to ensure operators and staff have a clear understanding of the disinfection process; • Recommended applying disinfection plan chlorine dosing levels in line with prevailing water quality and flow rates. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Cleaned out the ferric storage tank; • Designed an operational procedure for transfer of ferric sulphate from one storage tank to another; • Reviewed existing procedures for loss of coagulant with the Operations Team to ensure their understanding of these; • Designed an operational procedure incorporating a look-up table for manual transfers of sodium hypochlorite to the day tank; • Investigated the treatment works operation to establish whether automatic flow change in relation to clear water tank levels was required; • Reviewed the rapid gravity filter backwashing and the turbidity set points and confirmed whether turbidity backwash is activated; • Investigate the installation of a second ferric chemical delivery line to the dosing pumps; • Ensure the flow switch is installed on the temporary sodium hypochlorite transfer pump and is linked to alarms.

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<p>9 Nov 2016</p> <p>For 13 days</p> <p>Classification: Significant</p>	<p>Bayhead WTW and Clachan SR, Western Isles, North Region</p>	<p>1,016</p>	<p>Treatment failure – ammonium</p>	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by a dosing pump being set incorrectly when it was switched to manual resulting in an overdosing of ammonium sulphate; • The error was compounded by the lack of online ammonium monitoring and the availability of information about the nature of dosing system faults; • Sampling within distribution was poor, only 3 samples were taken for ammonium at customers' taps; • Recommended installing an online treated water ammonium monitor with alarm and autoshutdown facility; • Recommended providing simple ammonium instructions giving advice relating to global override conditions; • Recommended reviewing the sampling strategy during incidents. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Provided additional information to support on site operations on North sites without online ammonium monitors; • Increased the bench testing of ammonium at all North sites without online ammonium monitors; • Audited Uist operators' awareness in relation to the operation of site specific ammonia dosing and control systems; • Review the overall control and operation of the ammonium dosing system and instrumentation at Bayhead WTW • Create an improvement plan regarding the quality of site diary completion in the North Region.

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Nov 2016 to Jan 2017 For 3 months Classification: Significant	Carsphairn WTW, Dumfries & Galloway, South Region	88	Repeated detections of <i>Cryptosporidium</i>	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by an integrity failure of the membranes used as the primary treatment barrier which resulted in ten detections of <i>Cryptosporidium</i> oocysts in the water leaving Carsphairn WTW; • Investigations into the source of the oocysts were significantly hampered by poor sampling facilities at the treatment works; • Replacement of all the membranes finally halted the detections of oocysts in the water leaving the treatment works; • Recommended reviewing the effectiveness of membrane integrity testing on a site by site basis to ensure that the method employed is appropriate to the characteristics of each site; • Scottish Water will report back to DWQR on the approach to be used at each site. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Investigated the causes of the membrane failures; • Investigated the source of the oocysts; • Replaced the membranes in the treatment works; • Cleaned the tanks; • Implemented an enhanced monitoring process for oocysts.

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<p>29 Nov 2016</p> <p>For more than 3 days</p> <p>Classification: Significant</p>	<p>Tarbert Argyll WTW, North Region</p>	<p>1,761</p>	<p>Treatment failure – aluminium</p>	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by frozen sodium carbonate solution in the sodium carbonate dosing pipework which depressed the coagulation pH, resulting in a breach of the PCV (prescribed concentration or value) for aluminium; • Investigations into this incident are ongoing and the DWQR assessment has still to be finalised. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Decreased the sodium carbonate solution strength; • Ensured a new pH probe is available on site at all times; • Checked the performance and accuracy of the colorimeter used for alum tests; • Extend existing trace heating from the coagulation soda pumps to the injection points; • Investigate automatic changeover on soda pumps for coagulation pH and final water pH; • Investigate options for run to waste on coagulation pH and treated water aluminium; • Install a visual local alarm (on/off) on the soda tanks stirrer units.

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22 Nov 2016 For 3 days Classification: Serious	Moffat WTW, Dumfries & Galloway, South Region	3,114	Treatment failure – turbidity, aluminium and iron	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by a delay in completion of flushing to remove iron deposits following the cleaning of a borehole at Moffat treatment works which resulted in debris being dragged into the water supply when a neighbouring borehole was started up the following day to meet demand; • Recommended reviewing and updating the <i>Airburst</i>TM cleaning procedure at all Scottish Water borehole sites to ensure lessons learned are incorporated; • Recommended developing and disseminating an internal process to ensure that adequate, timely samples are taken in response to incidents. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Installed a raw water turbidity meter and connected this to telemetry; • Reviewed and updated the <i>Airburst</i>TM procedure at Moffat WTW; • Investigate whether the raw water turbidity meter could be programmed to allow automatic shutdown of borehole(s); • Conduct a Moffat works borehole cleaning procedure ‘lessons learned’ session with water operations treatment works team leaders; • Deliver escalation process training and guidance to all treatment works water operations teams; • Reinforce the ‘response to final water turbidity alarm’ procedure with all water operations treatment works teams.

Event Date, Duration & Classification	Area	Estimate of population affected	Nature and cause of the event	Main actions and findings from the DWQR investigation
<p>18 Dec 2016</p> <p>For 6 hours</p> <p>Classification: Significant</p>	<p>South Moorhouse WTW, Glasgow / East Renfrewshire, West Region</p>	<p>29,662</p>	<p>Treatment failure – aluminium</p>	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by a reduced oil level within a pump combined with the non-availability of a standby pump and failure to recognise that there was a volume of very poor quality water sitting within the treatment works; • Contributory factors included misdiagnoses of the causes of the failures, low water levels in the clear water tanks and a lack of maintenance staff knowledge and training on how the pump functions; • It is unacceptable that there was no standby lime pump for the critical process of pH coagulation control; • No targeted sampling of the distribution system was carried out in response to the high levels of aluminium leaving the treatment works for an extended period of time; • Recommended preparing and implementing a process for ensuring that adequate sampling is undertaken during events and incidents. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Replaced the pre-lime pump; • Reinstated the lime batching tank and cleaned both batching tanks; • Designed a procedure for South Moorhouse WTW to prevent poor quality water entering the network and briefed all operators on that procedure; • Liaise with Scottish Water’s Electric & Mechanical Team to better understand the requirements necessary to achieve a correct pump diagnosis and repair; • Investigate the cause of the delay in the procurement of a new pre-lime dosing pump and implement any lessons learned; • Review the overall performance of the South Moorhouse WTW team, identify any short-falls in training and/or performance and implement an improvement/development plan; • Provide refresher ‘operator awareness’ training and brief operators on the procedure for process failures.

Event Date, Duration & Classification	Area	Estimate of population affected	Nature and cause of the event	Main actions and findings from the DWQR investigation
26 Dec 2016 For 3 hours Classification: Significant	Turret WTW, Perth and Kinross, West Region	178,424	Treatment failure – aluminium	<p>DWQR comments and findings:</p> <ul style="list-style-type: none"> • The incident was caused by a blockage in a flow control valve which stopped flow to the pH monitor controlling sodium hydroxide dosing to the coagulation process; • A two and a half hour delay between the flocculator turbidity alarm being received by the ICC and Operations being notified of the alarm significantly affected the severity and duration of the incident; • No samples were taken in the distribution system, so the quality of the water at consumers' taps was unknown; • Recommended reviewing sampling staff availability during public holidays. <p>Scottish Water actions:</p> <ul style="list-style-type: none"> • Added daily flushing of the pH sample line to task scheduling; • Investigated and reported on a comparison of on-line bench and laboratory aluminium analyses; • Reviewed standard operating procedures for the flocculator turbidity alarm; • Investigated the delay in notifying the Operations Team about the alarm; • Determined whether plant shutdown could be added for the clarified water turbidity alarm setting.