dwqr

Drinking Water Quality Regulator for Scotland

DRINKING WATER QUALITY REGULATOR FOR SCOTLAND

Drinking Water Quality in Scotland 2022
Public Water Supplies Annual Report

SAFEGUARDING YOUR DRINKING WATER

Content

FOREWORD

This is the twenty first report from the Drinking Water Quality Regulator for Scotland (DWQR). The report provides a summary of the quality of Scotland's public water supplies for 2022. My report also describes my work during the calendar year 2022 in scrutinising the quality of drinking water provided by Scottish Water.

Scottish Water's customers continue to receive a supply of very high quality drinking water which they can use with confidence. The standard of drinking water quality in 2022 continues to be maintained at similar levels compared to previous years with only 116 of the thousands of samples taken from customers taps not meeting regulatory limits. This level of compliance is achieved through sustained efforts by Scottish Water to understand the risks posed to drinking water quality and mitigate against them so that there are no impacts on customers. This is done through rigorous treatment of water and extensive monitoring to verify the quality of the supply.

Where failures of standards occur these are investigated by Scottish Water to ensure the reason is understood and action can be taken. All data is reported to my team who review this and, if necessary, carry out further investigation. Of particular note during 2022 was the detection of bacteria at two of Scottish Water's service reservoirs which required customers to boil their water as a precaution whilst investigations took place. Our assessment showed significant failings in Scottish Water's maintenance of these assets. Further investigation into the approach to maintenance and inspection of service reservoirs has shown a backlog of inspection and repair. I am currently progressing enforcement action to ensure a robust programme of work is implemented to address this in the fastest possible time.

During 2022 our site audit programme of work returned to pre-pandemic levels of activity. Our findings from this work included highlighting issues relating to filter performance, ensuring consistent disinfection of the supply and the recording of information in relation to tankering activity. Recommendations for improvement have been given to Scottish Water which we will monitor these to ensure completion.

Our audits and incident investigations show the importance of maintaining the assets that are vital to the safe supply of water, as well as the potential risks to water quality when this work doesn't happen. Scottish Water must ensure that drinking water quality continues to be its top priority and that this is safeguarded through diligent operation, maintenance and investment in its water supply systems.

Sue Petch

Drinking Water Quality Regulator for Scotland

EXECUTIVE SUMMARY

In Scotland the public water supply is provided by Scottish Water. All other supplies are known as private water supplies, managed by owners and/or users. The Drinking Water Quality Regulator for Scotland (DWQR) regulates the quality of water supplied by Scottish Water, ensuring that drinking water supplies meet the requirements of The Public Water Supplies (Scotland) Regulations 2014 ("the Regulations"). This report describes the quality of the public supply provided by Scottish Water and the regulatory actions that DWQR has undertaken in 2022. DWQR publishes a separate report on private water supplies which you can view on our website at https://dwqr.scot/information/annual-report/.

Scottish Water takes and analyses its own samples to demonstrate that the water supplied complies with regulatory requirements. Samples are taken from drinking water as it leaves water treatment works (WTWs), service reservoirs (SR) (also referred to as storage points) and from randomly selected consumers' taps. This sampling and analysis is independently accredited and is consistent with water industry practice in the rest of the UK. DWQR assesses Scottish Water's monitoring programme and results.

In 2022, Scottish Water carried out a total of 297,284 regulatory tests on Scotland's drinking water with numerical standards and many more for operational reasons such as following a burst main. Of the 139,971 tests taken to represent water at consumers taps, 99.92% complied with the standards. In 2022 Scottish Water carried out sufficient water sampling as required by the regulations and the data shows a continued high level of compliance with standards. A further 60,671 tests were carried out on water supplied from treatment works and all but 25 of these tests met the required standards which is similar to the previous year's performance. 96,642 tests were also taken from service reservoirs (SR), where treated water is stored. Compliance here was similar to 2021's performance. However, in 2022 DWQR declared two incidents relating to regulatory sample failures at Darvel SR and Kerse SR.

Scottish Water also reports the numbers of 'contacts' received from consumers about the quality of their drinking water. There were 16,618 such contacts during 2022, which is a significant improvement on the 23,770 contacts received in 2021. Many of the customer contacts were received in 2021 due to an incident in central Scotland, where exceptionally low reservoir levels caused manganese to enter the treatment works, leading to discoloured supplies. It is therefore unsurprising to see a significant reduction in discoloured water complaints in 2022. It is noteworthy that there have also been reductions in the number of complaints relating to the taste and odour of the water supply. DWQR carries out formal complaint investigations if consumers are not satisfied with Scottish Water's own investigation. We carried out one investigation during 2022 related to discoloured water; this complaint was not upheld. Further information on Scottish Water's monitoring programme, results and consumer contacts can be found in Section 1 of this report.

Scottish Water is required to tell DWQR about any event that could affect water quality or cause consumer concerns. The number of water quality events reported in 2022 was 814. Events of a more serious nature are categorised as water quality incidents. In 2022, 26 events were declared to be incidents and investigated by DWQR. Significant loss of control of the water treatment process and issues causing significant customer concern were the most common cause of incidents. Section 2 of this report gives more details on some of the

incidents that we investigated during 2022.

Audit and inspection is a key part of DWQR's role. We inspect a range of Scottish Water activities and assets that could affect the quality of drinking water every year, auditing against regulatory requirements and industry best practice. Sites are selected for inspection using a risk based process that takes into account sample failures and water quality events and incidents. During 2022, nine incident and event investigation visits took place and 10 water treatment works were audited. Focused audits looking at particular topics were also undertaken, such as scrutinising Scottish Water's approach to borehole management and filter management. Further information on our audit and inspection work is given in Section 3 of this report.

Image 1 The DWQR, Sue Petch, Inspecting a Water Treatment Works in the Western Isles.

2022 in Review: Public Supplies in Scotland

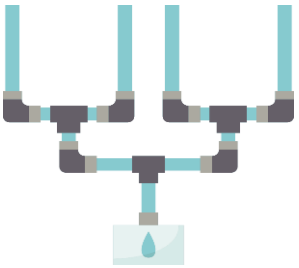
229 Water Treatment Works

964 Treated Water Storage Points

280 Water Supply Zones

672 Raw Water Sources

48640 km of water distribution pipes



297,284 tests were taken by Scottish Water

139,971 tests on customers' tap samples

116 tests at consumers' taps did not meet the standard

DWQR:

Reviewed 814 Water Quality Events

Declared 26 Incidents

Images supplied by Canva and Freepix

1. PUBLIC DRINKING WATER SUPPLIES IN SCOTLAND 2022

1.1 Water Treatment Works

Scottish Water has 229 water treatment works (WTW) that treat water to ensure it is safe to drink and complies with the standards set out in Regulations. Treatment works in Scotland range from large supplies serving whole cities to very small works that supply small communities consisting of only a few properties. Regardless of their size, DWQR expects Scottish Water to ensure that its WTW are capable of treating a range of raw water qualities found in water sources. 60,671 microbiological and chemical tests were undertaken on samples collected at treatment works. Of these, 25 (0.04%) failed to meet the required standards.

1.1.1 Microbiological Quality at Water Treatment Works

Coliform bacteria and *E. coli* are measured in water leaving WTW to check that disinfection of the supply has been successful. Coliforms are groups of bacteria widely found in the environment and *E. coli* is an indicator of faecal contamination. The presence of either parameter shows that the disinfection process may not have been effective at killing potentially harmful bacteria. The standard for both coliform bacteria and *E. coli* is zero and all sample failures must be fully investigated by Scottish Water and reported to DWQR, the local NHS board and the relevant local authority.

When investigating sample failures at WTW, Scottish Water considers a number of potential contributory factors, such as changes in the quality of the incoming raw water, issues with treatment processes, sampling conditions, and evidence from samples at the treatment works and in the distribution system. Further sampling can help establish whether there is a genuine problem and what this is. Data from on-line monitoring and manual testing of water at WTW for other parameters can also yield useful information. Samples taken at WTW continued to show that supplies in Scotland were of a very high microbiological standard in 2022.

Of the 25,285 samples taken in 2022, no samples failed the *E. coli* standard and 18 (0.07%) failed the standard for Coliform bacteria. Inverness WTW was the only treatment works to have more than one failure of the Coliform bacteria standard. The first sample failure, 1 CFU/100ml in May 2022, was attributed to a valve not closing properly following an integrity test of the membrane, thereby allowing raw water to temporarily pass through the membrane. The second failure, in October 2022, was highly unusual with 350 CFU/100ml detected. In response to the sample failure, the disinfection process was changed temporarily from chloramination to chlorination, and the system was dosed with an additional amount of chlorine. Further investigations found that the sample tap was likely to be the source of the micro-organisms and was replaced.

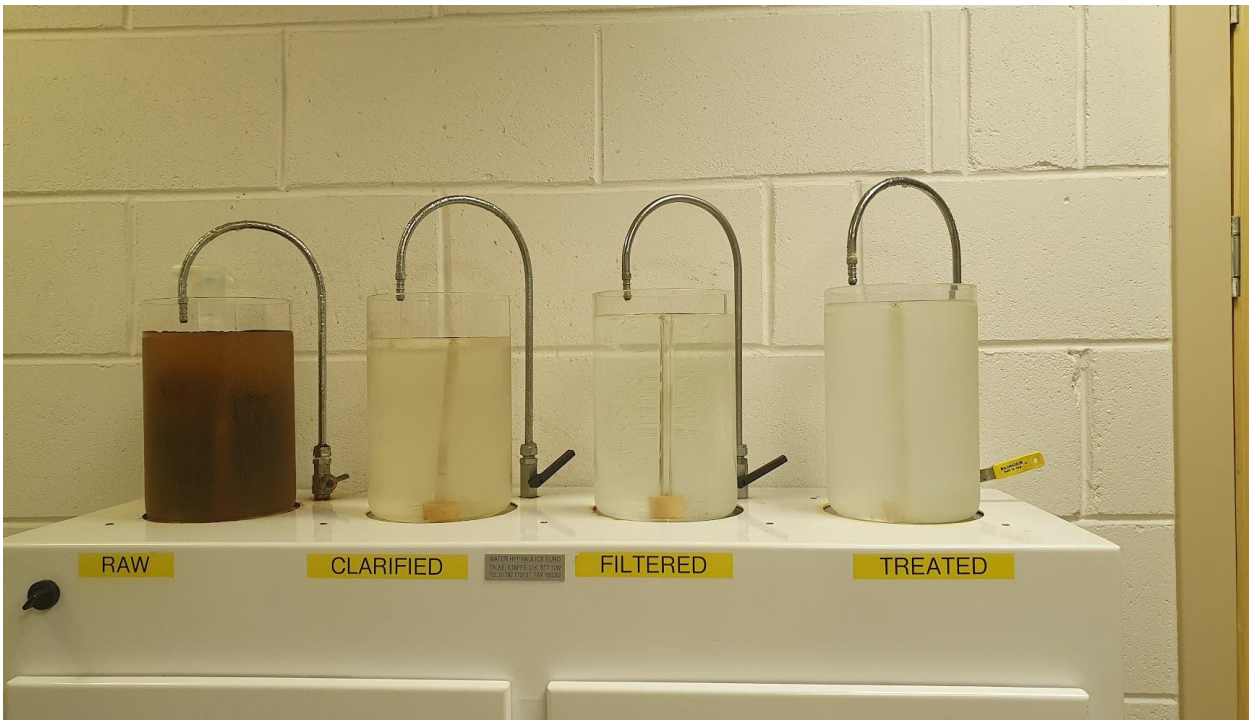


Image 2 Clarity Jars showing water appearance through the processes in a water treatment works

1.1.2 Cryptosporidium at Water Treatment Works

Cryptosporidium are microscopic protozoan parasites that can live in the gut of humans and warm blooded animals. *Cryptosporidium* oocysts can enter a water supply if faecal material is washed into the source (i.e. raw) water and the oocysts are not removed by the treatment process. *Cryptosporidium* oocysts are not killed by chlorine at the levels used in water treatment, and water treatment processes need to be optimised and well monitored in order to ensure they are physically removed. Scottish Water tests water supplies for *Cryptosporidium* to verify that these processes are removing oocysts. Ultra Violet (UV) light can be effective at inactivating oocysts. Scottish Water uses this process at a small number of sites where physical removal of oocysts by the original treatment process is not consistently achieved.

Scottish Water took 6,277 samples for *Cryptosporidium* in 2022. Mannofield WTW in Aberdeen had seven detections in 2022, the highest number for all treatment works in Scotland. DWQR served an Enforcement Notice on Scottish Water in June 2023; Mannofield WTW EN June 2023 (dwqr.scot). Alexandria WTW in West Dunbartonshire had *Cryptosporidium* detections in 2022, 2020 and 2018. An audit by DWQR in 2023 showed that the filters at the treatment works were not washing efficiently and that the coagulation process was not optimised. Additionally, there was evidence of aluminium concentrations increasing in the water from the secondary filters, which were installed for manganese removal, indicating a further risk from *Cryptosporidium*. A number of recommendations were made as a result of this audit; work being carried out to make improvements is being monitored by DWQR. Balquidder WTW had *Cryptosporidium* detections in both 2022 and 2021. In both years, the source colour and debris in the raw water were particularly high following heavy rain.

Image 3 A Membrane Treatment Process

In 2021, investigations showed that there were scratches on the surface of the membrane caused by pine needles bypassing the inlet strainer. In 2022 no issues with the membrane plant were determined but precautionary maintenance was carried out to minimise further risk.
Bonnycraig WTW in Peebles had a record of *Cryptosporidium* detections in the supply, with *Cryptosporidium* found in the final water in seven years out of nine. A new treatment works was installed at the end of 2022 which should now provide an effective barrier to *Cryptosporidium*.

1.1.3 Chemical Quality at Water Treatment Works

The Regulations require that water is tested for two chemical parameters, turbidity and nitrite, in samples taken from treatment works. Nitrite is a compound of nitrogen that can occur in supplies where ammonia is added to chlorine in a process called chloramination. This process needs to be tightly managed and the presence of nitrite in significant quantities can indicate that it is not as controlled as it should be. There were no exceedances of the nitrite standard at treatment works during 2022.

Turbidity is a measure of the extent to which particulate matter in the water scatters light – effectively how cloudy the water appears. There is a risk that turbid waters cannot be properly disinfected, so a treatment standard of 1.0 nephelometic turbidity units (NTU) has been set in the Regulations.

Image 4 Phosphate dosing at a WTW for Plumbosolvency (Lead) Control

There were seven turbidity tests that failed regulatory standards in 2022. Five were at Turriff WTW in Aberdeenshire and one was at Belmore WTW. At both sites the cause was the disturbance of deposits of lime added for pH correction of the supply. At Tomich WTW the cause was determined to be a broken sampling point.

1.2 Service Reservoirs

Service reservoirs (SRs) (also referred to as storage points) are located at points in the distribution system. They store water to meet the demand for water from consumers throughout the day. If service reservoirs are not maintained they can be prone to inward leakage from contaminated surface water. This needs to be controlled through inspection and maintenance. We inspect a selection of structures each year in order to ensure that they are being maintained and operated in a manner that minimises risk of contamination.

Compliance with microbiological standards at service reservoirs in 2022 showed a deterioration in performance compared to 2021 as Figure 1 below shows. From 48,321 samples, 49 (0.10%) samples did not comply with the Coliform bacteria standard.

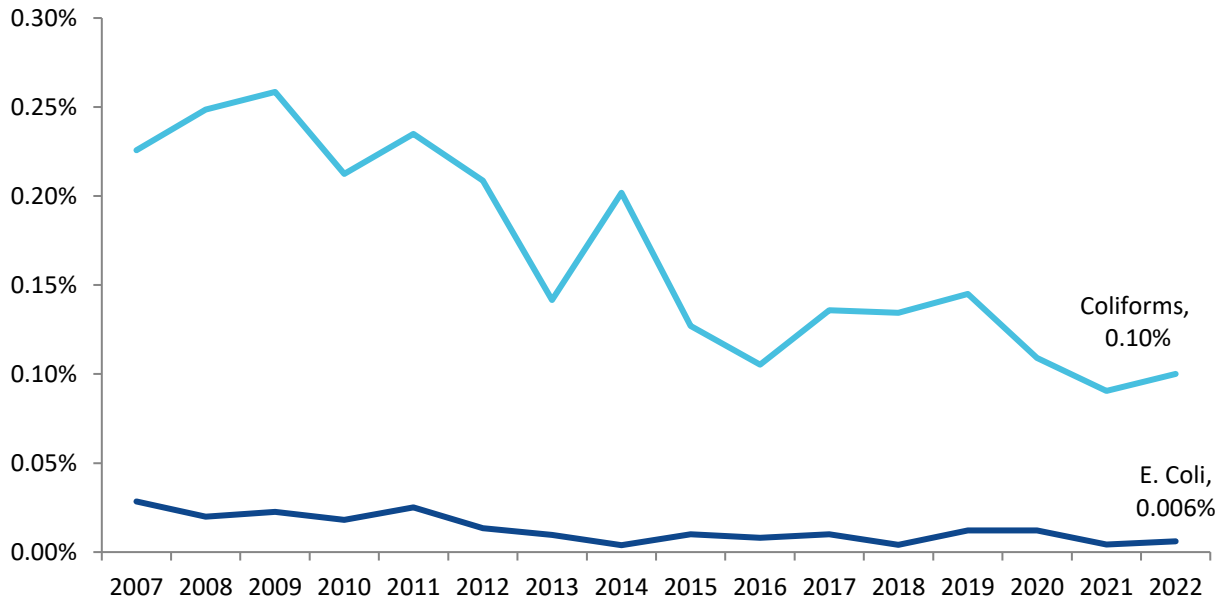


Figure 1 Microbiology Failure Rate at Service Reservoirs

Samples from three service reservoirs, 0.006% of samples, failed the *E. coli* standard – Methven Keillour SR, Darvel SR and Glassiebarns SR. Darvel SR also had six regulatory samples fail for Coliform bacteria, along with further operational samples failing to meet microbiological standards. Scottish Water's investigation identified areas of ingress into the tank. The tank was bypassed until remedial work could be carried out. This series of failing samples from Darvel SR was declared an incident by DWQR; further details can be found in Section 2.

The *E. coli* detection from Methven Keillour SR resulted in Scottish Water issuing a boil water notice to consumers for 24 hours whilst further investigations were carried out. Scottish Water's investigations of the external aspects of the reservoir found the site to be in good condition overall, with limited evidence of ingress into the tank. A previous inspection report from 2017 scored the tank as good/adequate for all internal and external parameters. After boosting the chlorine residual in the tank and taking further samples which all passed for microbiological standards, the boil notice was lifted. No clear root cause of this event was identified.

A sample taken from Glassiebarns SR failed both the coliform and *E. coli* standard. Investigations at the SR found no issues with the tank and there was a healthy chlorine residual at the time. Four resamples were taken, including two samples from downstream properties, which were all clear of Coliform and *E. coli* bacteria. Scottish Water found the sample point to be non-compliant and this is due to be replaced.

Darvel SR and two other service reservoirs also had more than one sample taken in 2022 which failed the Coliform bacteria standard. Oyne Westhall SR was found to have areas of ingress into the tank and was isolated from supply for remedial work to be undertaken. DWQR visited Oyne Westhall SR with Scottish Water and was critical that a previous inspection report highlighted areas of ingress into the tank yet there was no record of any remedial work having been carried out since.

Image 5 Temporary Protection at Darvel SR (Since Fully Repaired and Restored to Service)

Kerse SR was also found to have areas of potential ingress into the tank; there were significant delays in Scottish Water identifying this as the cause of the failures – this was declared an incident by DWQR and further details can be found in Section 2.

Following on from the incidents declared by DWQR relating to service reservoirs and examples of water quality failures relating to structural issues with tanks, DWQR issued an information letter in January 2023 requesting an annual data return on these assets. This included: dates of last inspection and clean; results of flood tests during inspections; whether the tank can be bypassed, and; details of any secondary chemical dosing.

1.3 Water Quality at Consumers' Taps

Scottish Water's supply area is divided into 280 water supply zones serving up to 100,000 people. Water is tested for 50 substances known as parameters, with sampling frequencies determined by the size of the population in the water supply zone. During 2020 and part of 2021, due to the COVID-19 pandemic, it was agreed that the usual approach of sampling at randomly selected consumers' properties was not appropriate and some zonal sampling took place at Scottish Water's storage points. Normal sampling at randomly selected consumer taps was reinstated at the end of June 2021, although this was briefly suspended at the end of 2021 due to the Omicron variant. As a result, 2022 is the first full year post-pandemic in which sampling has been undertaken in its normal manner at customers' taps.

Table 1 Summary of Failing Tests on Regulatory Samples From Consumers' Taps in 2022

Parameter	Total No. of Samples	No. Failed Samples	No. Zones with Failures	% Compliance in 2022	% Compliance in 2021	% Compliance in 2020
Bacteria						
Coliform Bacteria	14,806	38	29	99.74	99.83	99.87
E. coli	14,806	4	4	99.97	99.99	99.99
Clostridium perfringens	5,227	1	1	99.98	99.94	100.00
Total bacteria	34,839	43	34	99.88	99.91	99.94
Metals						
Aluminium	5,222	1	1	99.98	99.96	99.96
Copper	1,452	1	1	99.93	100.00	100.00
Iron	5,222	29	21	99.44	99.58	99.60
Lead	1,151	6	6	99.48	99.73	99.74
Manganese	5,222	17	15	99.67	99.37	99.71
Nickel	1,452	1	1	99.93	99.25	99.09
Total metals	19,721	55	45	99.72	99.61	99.73
Others						
Hydrogen ion (pH)	5,235	3	3	99.94	99.96	99.98
Nitrite	2,731	2	2	99.93	99.96	100.00
Odour	5,236	8	7	99.85	100.00	100.00
Taste	5,234	4	4	99.92	100.00	100.00
Total Trihalomethanes	1,450	1	1	99.93	99.86	99.93
Total Other Parameters	*49,820*	0	0			
Scotland Total	**139,971**	116		**99.92%**	99.92	99.95

* A supply zone can fail for more than one parameter. This means that the total number of zones that failed for at least one parameter is less than the sum of the 'No. Zones with failures' column

**Not all parameters are shown here. You can see the full list in the Supporting Information Table 11

This necessary change in sampling approach through 2020 and 2021 means that, although the correct numbers of samples were taken from supply zones during that time, the circumstances around their collection was different. Sampling at storage points during the pandemic meant the quality of water, and consequently the data from the sampling, was slightly altered. This can affect parameters such as iron, microbiology and plumbing metals in particular (e.g. lead and nickel) because domestic plumbing can greatly affect the quality of water after it has entered properties. As a result, in reviewing the 2022 data, DWQR will avoid drawing significant conclusions from year-on-year trends, but is able to draw some comparison to pre-pandemic trends.

In 2022, 139,971 tests were carried out on samples taken to represent water quality at consumers' taps. Of these, 116 failed to meet the standard set out in the Regulations.

Table 1 below shows the failing test results of samples taken to represent water at consumers' taps. Compliance for a number of key parameters is then discussed in more detail. The number of samples taken for each parameter that Scottish Water is required to test for is shown in the Performance Tables which accompany this report and can be found on our website. In addition to these regulatory samples, Scottish Water also takes samples for further investigation where the consumer reports an issue to ensure these are properly investigated.

Image 6 DWQR Inspecting Distribution System Activities on Islay

1.3.1 Microbiological Quality at Consumers' Taps

Coliform Bacteria

Coliforms bacteria were detected in 38 samples in 2022, with seven zones reporting two or more failures. The zone with the most failures (four sample failures) was Balmore C. These were all unrelated and mainly due to the cleanliness of domestic taps.

When coliform bacteria failures occur, Scottish Water takes further samples from the premises and also from neighbours' taps to determine if there is a local property issue or a wider supply system concern. Scottish Water notifies the consumer of the findings and provides the appropriate advice in each case.

E. coli

E. coli is an extremely important parameter because it is an indicator of faecal contamination and the microbiological safety of the water. The detection of *E.coli* in a water sample may be an indication that either the supply in that area or the tap from which the sample was taken has become contaminated. Some *E. coli* bacteria can cause illness. Scottish Water must investigate each failure thoroughly to try to determine the cause and respond appropriately.

Compliance for this parameter is relatively stable with only a few failures occurring each year. Four samples failed across separate zones in 2022.

Enterococci

Enterococci is also used as indicator of faecal contamination and the microbiological safety of the water. The numbers of *Enterococci* bacteria found in human faeces are generally an order of magnitude lower than *E. coli*, but they tend to survive for longer in the water environment and are more resistant to chlorination than *E. coli*.

Compliance for this parameter is relatively stable with only a few failures occurring each year. No samples failed for *Enterococci* in 2022.

Clostridium perfringens

Clostridium perfringens is a secondary indicator of faecal pollution. *Clostridium* spores can survive in water much longer than organisms of the coliform group and will resist disinfection by chlorine. Their presence in disinfected waters may indicate deficiencies in treatment. In distribution systems and at consumer taps, they can be an indicator of some historic contamination having occurred.

One sample contained *Clostridium* bacteria in 2022. However, resamples and reference samples from neighbouring properties all returned satisfactory results.

1.3.2 Chemical Quality at Consumers' Taps

Iron

Iron occurs naturally in some water supplies but should be predominantly removed by the treatment process. It is used as an alternative flocculant to aluminium at a few treatment works in Scotland. The most common cause of failures of the iron standard at consumers' taps is corroding cast iron water mains which can cause sediment to build up in distribution systems. High concentrations of iron can cause discoloured water supplies, greatly inconveniencing consumers.

Scottish Water continues with a programme of renovation and cleaning of the water mains that cause the most significant water quality issues. This should have the effect of reducing the number of complaints about discoloured water in the future.

Iron compliance in 2022 deteriorated slightly compared to 2021, with 29 tests failing to meet the standard, a compliance of 99.44%. As many samples during 2020 and 2021 were collected at Scottish Water's storage points rather than consumers' taps, these samples should be less vulnerable to local disturbances in water mains, so it is unsurprising that there has been a slight increase in the number of tests failing to meet the standard in 2022. It is noteworthy that compliance in 2022 has improved compared to 2017, 2018 and 2019.

Manganese

Manganese occurs naturally in some raw waters, especially in the West of Scotland. If it is not removed effectively by the treatment process it can accumulate as fine black sediment in distribution system pipework and cause severely discoloured water supplies and great inconvenience for consumers. Even a relatively low concentration of manganese in water from a treatment works can build up in pipes and cause problems in distribution pipework. 17 samples failed for manganese, compared with 33 in 2021 and 15 in 2020. This decrease is likely to be almost exclusively due to an incident in Summer 2021 in Lanarkshire, which resulted in a significant increase in samples failing for manganese. Compliance for manganese in 2022 was at a similar level to that seen in previous years.

Lead

Lead is a toxic metal that can accumulate in the body. In Scotland, lead generally does not occur naturally in significant concentrations in our water supplies. The problem arises when drinking water comes into contact with lead supply pipes, lead tanks, and lead solder joints on copper pipes, or inferior quality brass fittings and taps, particularly for longer periods (e.g. overnight/weekends/holiday periods). This can result in high lead levels in the drinking water supply. Although the majority of lead piping is privately owned and therefore outside Scottish Water's direct control, the company does have a responsibility under the Regulations to minimise the risk from dissolved lead. It does this by treating the water with orthophosphate to reduce the risk of lead dissolving from pipes.

The Scottish Government is reviewing the policy in relation to the reduction of exposure to lead in drinking water, especially in light of the recast Drinking Water Directive. The project aims to raise awareness of consumers to the concerns about lead in drinking water and to promote the removal of lead service pipes and

plumbing. Within this, DWQR commissioned Scottish Water to carry out a surveillance programme for lead within independent schools and nurseries. At the end of 2022, Scottish Water had completed 80% of this project, with an overall compliance of 98.57%. Scottish Water has also undertaken a project to explore lead removal and assess the practical issues encountered in replacing lead pipework in people's homes and gardens as part of its lead strategy, along with sharing learnings with other UK water companies.

In 2022, six lead failures were detected. This increase from 2020 and 2021 is unsurprising as sampling from customer taps was limited during previous years as a result of the COVID-19 pandemic. This is still a decrease from lead failures pre-pandemic; there were 14 failures in 2017, 15 failures in 2018 and seven failures in 2019. In addition to the 1,151 regulatory lead samples taken, Scottish Water take many more for operational reasons such as consumer request or survey work. A greater proportion of these samples fail the standard as they are generally taken from properties known to have lead pipes.

Total Trihalomethanes (THMs)

THMs is a group of disinfection by-products that can form when naturally occurring, harmless organic substances combine with chlorine used to disinfect water. As Scotland's upland waters are often rich in these organic compounds, management of THM formation presents a challenge for Scottish Water. Scottish Water has devoted much effort to reducing the formation of THM in its water supplies and has made significant progress on this issue.

One exceedance of the THM standard occurred in 2022, from Lochinvar water supply zone that serves parts of Dumfries and Galloway. Scottish Water investigated and found that organic material in the raw water had increased, with the coagulation process at Lochinvar WTW not fully optimised for colour removal. The slight increase in treated water colour was enough to significantly increase THM formations in the downstream network. Increased monitoring at the WTW and tighter thresholds on site for colour removal have been implemented to improve performance.

Nitrite

Nitrite forms when nitrifying bacteria react with the ammonia that is added to chlorine in a process known as chloramination. If the process is not carefully controlled and nitrifying bacteria are allowed to persist in the distribution system nitrite can build up and cause failures in the standard. Bacteria can persist due to water lying in pipes for long periods, especially in warmer weather. There were two failures of this parameter in 2022 from Mannofield East in Aberdeenshire and Roberton in the Scottish Borders.

Nickel

Nickel is not found in high concentrations in Scotland's waters. However, it is used in the production of stainless steel and other metal products. Its presence in drinking water generally arises from contact with plumbing fittings, such as nickel or chromium-plated taps or certain types of kettles.

One nickel failure occurred in 2022, which is an improvement compared to the poor results of 2021 and 2020. This improvement may in part be due to the high proportion of samples in 2021 and 2020 collected from Scottish Water's own taps due to the COVID-19 pandemic. This could indicate that Scottish Water needs to

replace some of its sample taps at its service reservoirs.

Taste and Odour

There were four taste failures in 2022, all occurring in separate supply zones. In three of the taste failures, Scottish Water was unable to identify a cause with subsequent investigative sampling being unable to exhibit the same characteristics. Scottish Water undertook further sampling and investigation for the remaining failure; it found that in the two properties sampled, low levels of Chloroanisoles had formed after Chlorine treatment. These were at very low levels, well below the health-based triggers, but above the normal threshold for being detectable by taste and odour.

Eight samples failed for odour across seven supply zones. Two of these failures were related to an incident at Carron Valley WTW, in which Geosmin levels in the raw water rose significantly and the works was not capable of treating this. Further information on this incident is available in Section 2.

Another failure was in Turriff for anisole. These can be formed following chlorine treatment. The levels detected were not at significant concentrations to affect the health of the consumers. In another sample in Forehill, bromobutane compounds were detected but Scottish Water was unable to determine if they were the source of the odour. No determinate cause was identified for four odour failures; resamples from consumers and neighbouring properties were satisfactory.

Turbidity

Turbidity in water is caused by suspended particles or colloidal matter that obstructs light transmission through it, making it appear cloudy. The standard is primarily an aesthetic one but high turbidity needs to be investigated, especially in water leaving treatment works. It could indicate a problem with the treatment process and may mean that the effectiveness of disinfection has been compromised. There were no failures of the turbidity standard at consumers' taps in 2022.

Hydrogen Ion (pH)

The pH of a substance is the measure of how acidic or alkaline the water is. Most waters in Scotland are naturally soft and have a low pH. Such water can be corrosive to metals used in plumbing, therefore Scottish Water needs to correct this to bring the pH into the required range. High pH values can occur where water is in prolonged contact with water mains containing cement. Waters with a very high pH can have a taste that some consumers find unpleasant. Three samples failed the standard for pH in 2022. Two of these were from supply zones in the Glasgow area (unrelated), with the third being from Lochinvar water supply zone in Dumfries and Galloway.

1.4 Consumer Contacts

1.4.1 Consumer Contacts to Scottish Water

When a consumer calls Scottish Water regarding the quality of their water supply, the contact is recorded and classified according to the nature of the issue. Scottish Water received 16,618 consumer contacts relating to water quality in 2022, equating to a contact rate of 30 per 10,000 population served. This is a decrease from 2021 when there were 23,770 contacts and the overall contact rate was 44 per 10,000. The number of discolouration consumer contacts are also lower from 17,887 in 2021 to 12,251 in 2022. The majority of these consumer contacts received in 2021 for discolouration were due to an incident in central Scotland, where exceptionally low reservoir levels caused manganese to enter the treatment works, leading to discoloured supplies.

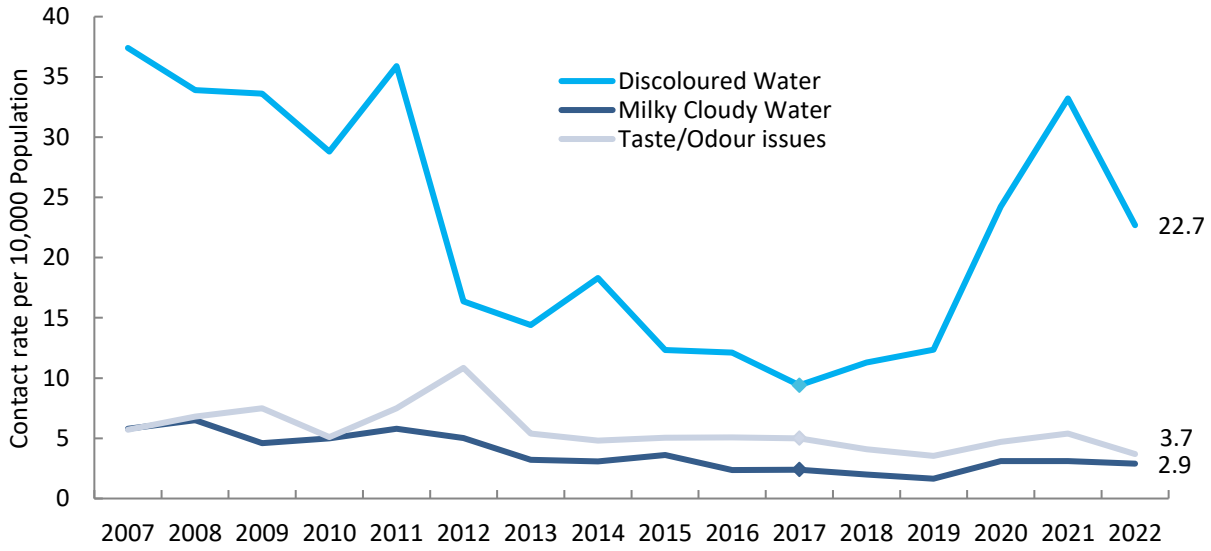


Figure 3 Breakdown of Water Quality Customer Contacts by Type

In geographic terms, the areas where most issues were raised by consumers are shown in Figure 4. There are nine zones where more than 300 contacts were received, which is a decrease from fifteen the previous year. The chart below shows the supply zones ranked by contact rate with most being received from consumers.

Discolouration receives the largest percentage of customer contacts across all zones with Daer Zones continuing to have the largest percentage of contacts in this category, although the number of contacts overall for discolouration in these areas has reduced considerably.

Another area of interest is the increased number of customer contacts for musty/earthy taste in Carron Valley Zones A and B. This has increased from 19 contacts in 2021 to 75 in 2022 in Carron Valley A; and 23 to 86 in Carron Valley B. This is due to a water quality incident that occurred at Carron Valley WTW during the summer of 2022, where there was an increase in the growth of algal blooms and their release of geosmin (one compound that is responsible for an earthy taste) into the water. From 1st July to 31st October there were a total of 241 taste and odour customer contacts, 193 of which were classified as earthy/musty. More details on this incident can be found in section 2 Events and Incidents.

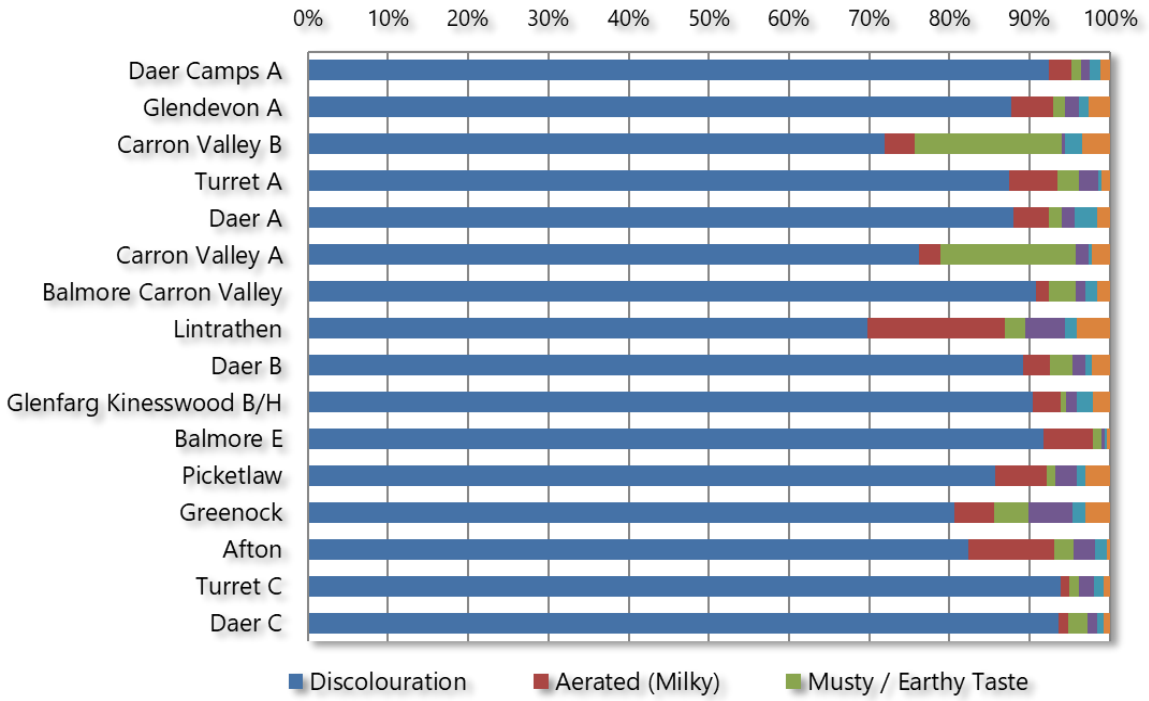


Figure 4 Water Supply Zones with the most consumer contacts in 2022

Table 2 Consumer Contacts Received by DWQR in 2022

Contact Category	Number of Contacts				%	Contact rate per	
	2022	2021	2020	2019	Change	2022	2021
Appearance							
Discoloured Water	**12,251**	17,887	12,989	6,623	-32%	22.4	32.7
Aerated (Milky) Water	**1563**	1,662	1,660	882	-6%	2.9	3.0
Particles in Water	**469**	543	553	365	-14%	0.9	1.0
Organisms in Water	**32**	30	40	33	7%	0.1	0.1
Taste and Odour							
Chlorine	**522**	731	985	578	-29%	1.0	1.3
Metallic	**347**	602	356	358	-42%	0.6	1.1
Solvent/Fuel Taste/Smell	**13**	14	31	21	-7%	0.0	0.0
Musty/Earthy	**725**	1,058	621	639	-31%	1.3	1.9
TCP/Chemical Taste/Smell	**381**	505	525	302	-25%	0.7	0.9
Other Water Quality Contact							
Illness due to Water	**315**	733	286	240	-57%	0.6	1.3
Other Contact	**0**	5	96	617	-100%	0.0	0.0
Total Contacts about Water Quality	**16,618**	23,770	18,142	10,124	-30%	30.4	43.5

Tier Two Investigations of SW Consumer Complaints

We carried out a formal investigation of one complaint against Scottish Water in 2022. It was due to an incident of discoloured water. We have summarised it below and the full determination of the case is available on the DWQR website https://dwqr.scot/regulator-activity/consumer-complaint-investigations/consumer-complaint-determinations/.

The customer contacted DWQR in June 2022 to advise that they were unhappy with the colour of their water and had gone through Scottish Water's complaints process. The customer first contacted Scottish Water on 10th November 2021, following the fire hydrant outside the property being opened as part of Scottish Water flushing activities following a burst water main. The property was sampled on the 12th of November 2021. Following receipt of a written complaint on 12th March 2022, a further sample was taken by Scottish Water on the 24th of March 2022, for both samples the analytical results complied with the water quality standards set out in the Regulations.

During the investigation DWQR investigated customer contacts in the area. A total of 25 customer contacts were made in this area in 2021 to 2022 and 22 of these came from 5 operational events such as a burst mains. Scottish Water's Drinking Water Safety Plan was also considered and, although there is a known risk of discoloration from the trunk main, all statutory samples taken in the area showed that metal concentrations and turbidity were low.

DWQR did not uphold the complaint, as Scottish Water responded in a reasonable and thorough way, showing that the water is now compliant as well as providing appropriate and correct information and advice relating to discoloured water.

2. WATER QUALITY EVENTS AND INCIDENTS

Scottish Water is required to tell DWQR about all events that have affected or could affect water quality or cause concern to consumers. This includes: all regulatory sample failures; operational sample failures that are significant or unexpected; any failure of a treatment process; significant numbers of consumer contacts, and; issues which attract significant media interest.

Each event is reviewed and classified into one of five categories: not significant, minor, significant, serious or major. Those events categorised into one of the latter three categories are classed as incidents requiring further detailed investigation by DWQR. Where further information is required, a full report may be requested from Scottish Water. It should be noted that where a full report is not requested, this does not suggest in any way that the incident is less serious.

Incidents are fully investigated by DWQR Drinking Water Specialists who produce a written assessment and make recommendations where appropriate. As part of the investigation, DWQR staff often visit Scottish Water sites to talk to Scottish Water employees and examine equipment failures. A short summary of the incident assessment is published on the DWQR website. For the most serious incidents, enforcement action or prosecution may be considered.

There were 814 events reported to DWQR during 2022, the majority of which were not classified as significant or above. Table 3 shows the numbers of incidents and the Scottish Water operating areas where they occurred. A summary of incidents is available on the DWQR website at https://dwqr.scot/regulator-activity/water-quality-incidents/

Table 3 Drinking Water Quality Incidents Assessed by DWQR in 2022

	Significant	Serious	Major
EAST	8	0	0
NORTH	4	1	0
SOUTH	6	0	0
WEST	5	2	0
SCOTLAND	**23**	**3**	**0**

26 of these events were classified by DWQR as incidents, which is 6 fewer than 2021. The reasons events were classified as incidents in 2022 are illustrated in the chart in Figure 5.

Six incidents were declared due to a significant loss of control of treatment process, with a further six incidents causing significant customer concern or media interest. Some of the customer concerns relate to discoloured water, milky/white water or taste and odour. In certain cases, planned interventions within the water mains network cause these issues and in others, it arises from the need to manage supplies due to issues with the distribution network such as burst water mains. In either case, Scottish Water is expected to manage its network effectively to minimise the impact on consumers.

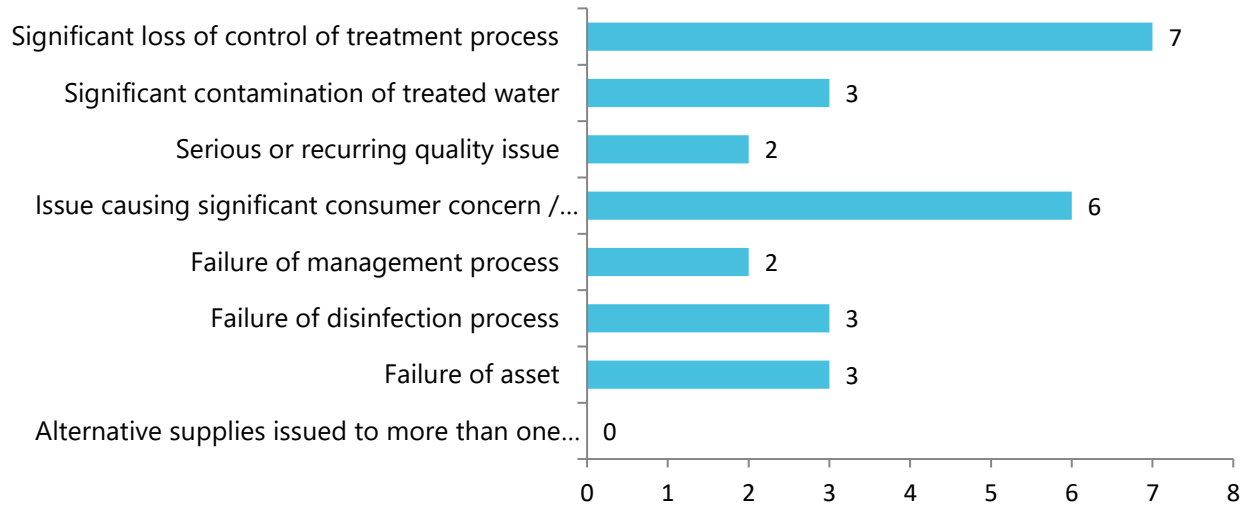


Figure 5 Reason for Declaration of an Incident in 2022

The number of incidents where a causal factor was failure of part of a treatment works is half that of 2021, which is to be welcomed, although it is still too high. A further three incidents were the result of a failure of the disinfection process, something which is fundamental to the protection of public health.

A summary of each Incident Assessment can be viewed on the DWQR website 2022 Incidents (dwqr.scot). A number of these are worth highlighting as they illustrate significant consumer issues or present important learning points for Scottish Water. These are set out below.

Carron Valley B RSZ (Central Scotland)

Taste and Odour Complaints - July 2022 - Significant

Following taste and odour issues in 2021, caused by small amounts of the algae-derived compound geosmin, Scottish Water implemented twice weekly sampling and analysis of raw and final water for geosmin at Carron Valley WTW. Results from samples taken on the 5th July showed that Scottish Water's trigger value of 5ng/l geosmin in raw water had been exceeded, with results of 7.81 and 14.52ng/l. On Friday 15th July, Scottish Water decided that dosing of powdered activated carbon (PAC) at the treatment works should be started to help control geosmin levels.

Despite this treatment, the measured levels of geosmin in the raw water in 2022 were much higher than those in previous years, and final water geosmin levels were significantly higher than the taste and odour threshold of around 5ng/l. 1 sample exceeded 26ng/l. A number of consumers contacted Scottish Water to report taste and odour concerns from 1st July to 31st October there were a total of 241 taste and odour contacts, 193 of which were classified as earthy/musty, the classic sign of geosmin in water.

Scottish Water has committed to undertake work to improve the processes for preventing and removing geosmin from the water at this large site which serves Falkirk and parts of Stirlingshire.

Lochinver WTW (Highland)

Treatment Issue - May 2022 – Serious

On 6th May the automatic membrane cleaning process failed, as the required valves were closed. The operator restarted the works and noted a high permeate turbidity alarm as well as low post chlorine contact tank and treated water chlorine residuals, so started running the site to waste by turning off the treated water pumps. It was identified that some of the cleaning chemicals had entered the process stream when the wash failed, and the process science team confirmed that there was forward flow when the works was offline for one hour. This instigated an escalation to the public health team (PHT) and then the team manager. A visual inspection of the clear water tank (CWT) revealed a sheen on the surface of the water, so all forward flow was stopped, with the works running to waste. With the water to supply isolated, tanker support and bottled water were arranged with 'Boil Notices' and consumer communications issued.

The network was drained and flushed overnight to remove any chemicals from supply. Flushing was paused the following morning due to increased demand then recommenced once the CWT had recovered. The main washing chemical was citric acid, so sampling concentrated on looking at pH levels as an indicator. Turbidity and chlorine demand had also increased and were monitored within the network. These returned to normal by the evening of 7th May and so flushing was suspended. Bottled water stations were maintained in the community until the results of the microbiological and *Cryptosporidium* sampling were returned as satisfactory by the evening of 8th May and the Boil Notice was lifted.

It should be noted that due to the dilution of the chemicals in the CWT and that these were mainly composed of citric acid, there was no risk to health from the ingestion of the chemicals themselves; any risk was considered due to the increased turbidity and lack of disinfection. Scottish Water's detailed incident investigation concluded that this incident was caused by membrane cleaning chemicals entering the treatment stream, most likely via siphonage from the chemical tank through the membranes. The automatic valve of the limestone contact tank then opened fully to mitigate the low pH, and the increased flow through the bed and the low pH dissolved many of the larger limestone fines and caused turbidity to rise. There was a total loss of chlorine residual from dosed and post contact tank monitors which suggests that the chemicals scoured the membranes of organic carbon and biofilm and metals, which spiked chlorine demand. Scottish Water identified 6 actions which DWQR accepts are appropriate and will monitor to ensure they are completed prior to signing off the incident. DWQR made one additional recommendation.

Kerse Service Reservoir (Central Scotland)

Repeat microbiological failures - September to December 2022 - Serious

A scheduled regulatory sample taken from Kerse Service Reservoir on the 1st September 2022 contained Coliform bacteria. Its resample taken on the 3rd September also failed. On the 6th September a 'preliminary high-level inspection' of the tank was carried out; no problems were observed, but issues were found with the sample tap as it was not compliant with Scottish Water's latest specification. A regulatory sample from the 20th September also failed the Coliform bacteria standard, but the sample from the 24th was satisfactory. The absence of *E. coli* and the low levels of Coliform bacteria in the samples (1 or 2 CFU/100ml) led Scottish Water to assume that the sample point was the source of the failures, so between the 27th and the 29th September

the sample line and tap were relocated and replaced.

Four samples taken during the commissioning of the new sampling arrangements were taken between the 30th September and the 7th October; one, from the 1st October, failed the Coliform bacteria standard while the other samples were satisfactory. Enhanced sampling from the tank sample tap, dip sampling of the tank and increased downstream sampling was started on the 3rd October, and three sample tap failures were recorded on the 7th, 12th and 17th October, along with a dip sample failure on the 12th October. Contractors were then engaged to remove the tank from service to clean and inspect it and the tank was drained on the 25th October. The tank failed flood testing in various locations, indicating ingress was possible, and there were visible holes in the roof and walls and 'significant amounts of debris and animal remains' were found on the floor of the tank. The tank remained offline to allow repairs to be made by contractors and the works were completed by the 19th December, when the reservoir was returned to supply.

A structural inspection carried out in July 2008 had identified a number of issues with the reservoir, including ingress, however the reservoir remained in service without any temporary measure in place to mitigate these risks.

DWQR has been extremely critical in the delayed response to these failures, and the lack of appropriate maintenance of the tank, and is preparing enforcement action on the subject of storage point maintenance.

Darvel Service Reservoir (Ayrshire)

Microbiological Contamination - September to November 2022 - Serious

A scheduled regulatory sample from Darvel SR on 15th September 2022 contained Coliform bacteria and the resample taken on 17th September also failed. A sample taken from a downstream property complied with microbiological standards. A contractor was engaged to clean and inspect the tank, but taking the tank out of service presented a significant risk to the resilience of the supply. The regulatory sample from 20th September also failed the Coliform bacteria standard; again the resample failed and the distribution sample passed. After further failures, the local Network Service Operator (NSO) and the Process Scientist carried out a 'high level preliminary investigation' at the tank but found 'no obvious signs of ingress'. Scottish Water replaced the sample line from the tank on 28th September and samples taken from the new sample line and a dip sample both passed microbiological tests, although a scheduled regulatory samples on 29th September and 1st October also contained Coliform bacteria. On 5th October, Scottish Water had a 'brief discussion' with the local Health Board and local authority at a scheduled liaison meeting and advised that the sample failures were likely caused by issues with the sample tap. The failures continued. On 13th October the sample line and tap were disconnected and were replaced with a new sample tap kiosk by 25th October. No samples were taken from the tank during this time but samples taken from the network during this period complied with standards.

On 19th October the tank was cleaned and inspected by a contractor; the contractor reported that without a tarpaulin on the roof of the tank, it would have failed its flood test and that there was 'visible significant ingress in multiple locations'. A post clean dip sample failed the Coliform bacteria standard from 20th October when the tank was out of service. The tank was returned to service on 24th October, but on 27th October a network sample failed and resamples from 29th and 31st October also failed. On 2nd November a regulatory

sample from the outlet of the tank, which had been taken the day before, was reported to have failed the standard for *E. coli* and the tank was removed from service the following day. NHS Ayrshire and Arran Health Protection Team was informed. In total there were 23 microbiological failures during this incident.

The cause of the incident was ingress of surface water into the treated water storage tank. The event has been categorised as Serious. Scottish Water identified seven actions which DWQR accepts are appropriate and will monitor to ensure they are completed prior to signing off the incident. DWQR made two additional recommendations. As with the Kerse incident described above, DWQR is extremely concerned by the condition of these tanks and Scottish Water's response to the failures. Enforcement action is in progress.

Image 7 Aerial view of Darvel SR (Repaired) – Image supplied by Scottish Water

Picketlaw WTW (Renfrewshire)

Loss of Supply and Discolouration - December 2022 - Significant

A loss of supply from the treatment works and subsequent disturbance to sediment in the network which led to discolouration and water quality failures was caused by a loss of the coagulation process. This was due to a failure of the coagulation lime system for pH correction and a burst hose delivering the polyelectrolyte coagulant aid. The situation was significantly exacerbated by low storage levels in the network following a period of cold weather when the network had been subjected to freeze/thaw conditions.

There were 80 consumer contacts for water quality, and 562 contacts for no water, low pressure or bottled water requests. 38 samples were taken during the incident. One sample contained *Enterococci* at the treatment works. In the distribution system, the following failures of the standards occurred; two for aluminium, five for iron, nine for manganese and two for turbidity.

Scottish Water responded well to the incident but there were issues with sampling deficiencies.

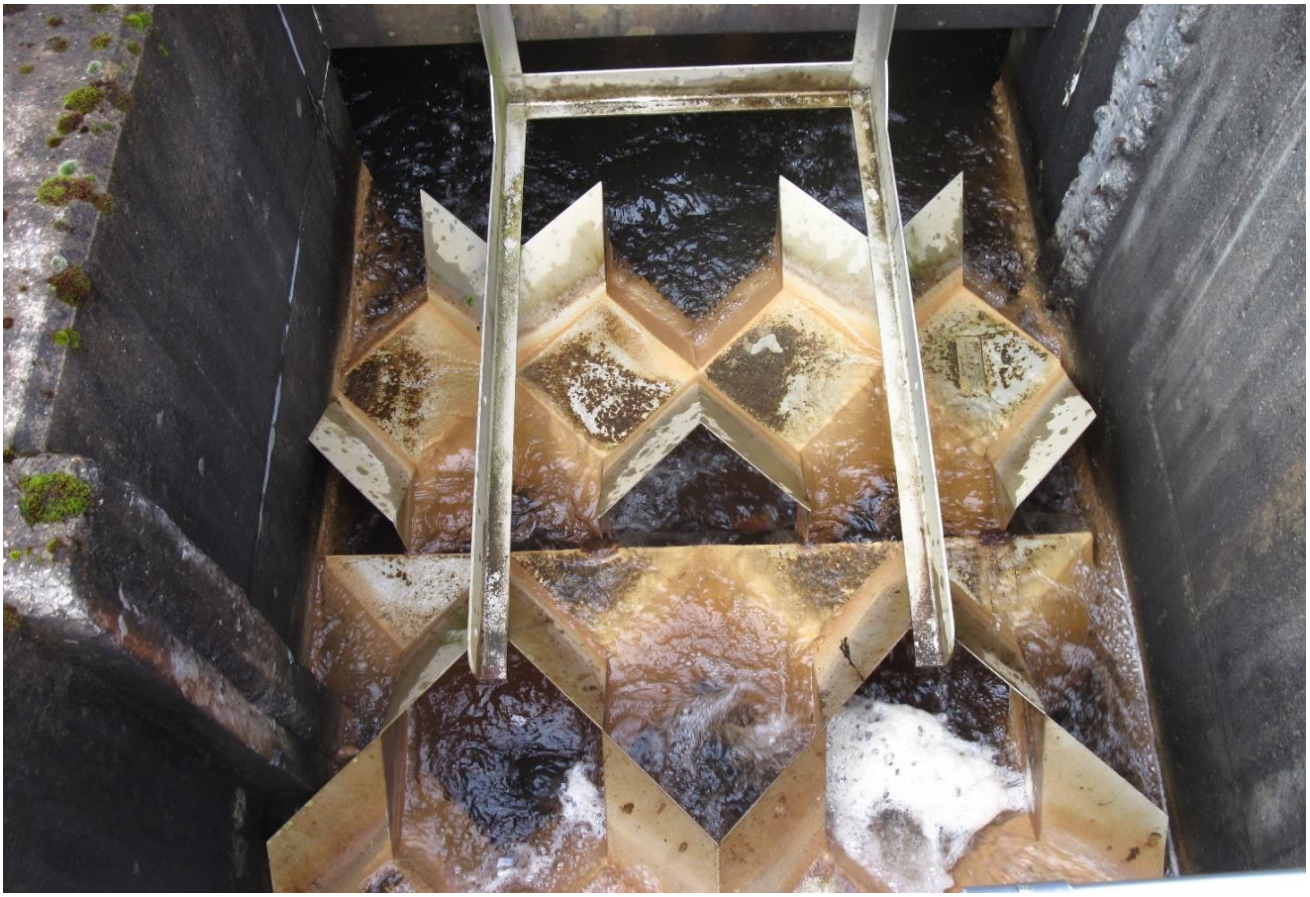


Image 8 Coagulation Chemical Mixing at Water Treatment Works

3. AUDIT AND INSPECTION

3.1 Water Treatment Works and Service Reservoirs

An important part of DWQR's scrutiny role is to audit and inspect activities undertaken by Scottish Water. We can choose to inspect any aspect of Scottish Water's activities that could affect water quality.
Inspections commonly undertaken include WTW, storage points, distribution system activities, response to consumer water quality issues and analytical services. We audit against the requirements of the Regulations, as well as water industry best practice. We also audit the completion of investment projects.
The inspection process provides a number of benefits:

- It enables DWQR to verify that Scottish Water is complying with regulatory requirements at sites across Scotland;
- It allows DWQR to see new initiatives and areas of best practice;
- It is an opportunity for DWQR staff to meet site-based Scottish Water staff and discuss water quality issues with them;
- It raises awareness of DWQR and the Regulations amongst Scottish Water staff;
- It enables verification of the delivery of investment work;
- It enables DWQR to build an awareness of common trends, risks or deficiencies across Scotland and use these to inform future policy and guidance.

We select sites for inspection using a risk based process that takes into account sample failures and water quality events and incidents. DWQR may also choose to inspect sites randomly or directly following incidents. Other types of inspection may be undertaken in response to a particular issue or concern.

To make sure we are consistent all our inspectors use standard inspection templates and the audit process is subject to an ISO accredited procedure. DWQR also participates in benchmarking audits with other regulators in the UK and beyond to drive consistency and to spread best practice.

Where issues are noted during an inspection these are recorded as recommendations that are tracked and followed up. Where common themes are identified, these are progressed centrally with senior Scottish Water staff. Elements of best practice are also highlighted. Scottish Water has an opportunity to comment on draft inspection reports and co-operates fully during the technical inspection process.

Once an inspection report has been finalised the completed report is sent to Scottish Water and a summary placed on the DWQR website. You can view the DWQR audit and inspections reports on our website at https://dwqr.scot/regulator-activity/audit-and-inspection/

3.1.1 Water Treatment Works

During 2022 ten technical audits were carried out at WTW. Our findings highlighted the maintenance and upgrade of ageing assets to maintain quality; the review of *Cryptosporidium* risk; filter performance and ensuring consistent disinfection.

Table 4 DWQR Site Visits for Audits in 2022

Location	Date	Reason for audit	Number of Recommendations
Camphill, Ayrshire	March	Risk Based	12
Moffat, Dumfriesshire	April	Risk Based	9
Aviemore Boreholes, Highland	April	Risk Based	4
Port Charlotte, Islay	June	Risk Based	8
Torra, Islay	June	Risk Based	7
Balmore, East Dunbartonshire	July	Risk Based	8
Rawburn, Scottish Borders	September	Risk Based	11
Lintrathen, Angus	October	Risk Based	5
Castle Moffat, East Lothian	November	Risk Based	11
Ringford, Dumfriesshire	November	Risk Based	5

Image 9 Water Treatment Works on Islay

In addition to full technical audits we also made 21 other site visits. These were to assist our investigations into events and incidents to interview staff and increase our understanding of situations that had arisen. Visits were also made to increase inspector awareness and to inspect the progress of Enforcement Notices and works that have had significant investment. On one occasion we visited and interviewed consumers who had been affected by an incident. These are recorded in Table 5.

Table 5 DWQR Site visits for Incident Assessment, Investment and Performance Monitoring during 2022

Location	Date	Reason for audit
Loch Ness Regional	January	Investment
Fort Augustus, Highland	January	Operational resource
Invermoriston, Highland	January	Operational resource
Inellan, Dunoon	February	Incident assessment
Turriff	March	Enforcement Notice compliance
Rawburn, Scottish Borders	April	Incident assessment
Bradan, Ayrshire	April	Event assessment
Rosebery, Midlothian	May	Incident assessment
Turriff, Aberdeenshire	June	Site Visit
Herricks, Moray	June	Site Visit
Bonnycraig, Scottish Borders	August	Enforcement Notice compliance
Invercannie, Aberdeen	September	Investment
Killin, Tayside	September	Incident assessment
Craighead, Aberdeenshire	September	Investment
Glenlatterach, Moray	September	Investment
Kirkmichael, Perthshire	September	Incident assessment
Darvel SR, Ayrshire	October	Incident assessment
Oyne Westhall SR, Aberdeenshire	October	Event assessment
Inverness	November	Event assessment
Mannofield, Aberdeen	November	Capital works
Carron Valley, Falkirk	November	Operational resource

Image 10 Fort Augustus WTW

3.1.2 Distribution Systems

We audited ten distribution systems and service reservoirs (SRs) in 2022. Our findings included recommendations to ensure the hygienic storage of fittings and the additional controls needed for temporary storage to secure water quality.

Table 6 Distribution System Audits in 2022

Location	Date	Reason for audit	Number of Recommendation
Lintrathen RSZ	May	Network Rehabilitation	3
Conisby SR	June	Operational practices	3
Octomore SR	June	Risk based	0
Bowmore SR	June	Risk based	1
Bowmore RSZ	June	Network Rehabilitation	2
Croy PRV	August	Maintenance	0
Drumbuie SR	August	Maintenance	0
Loch Lomond catchment and Ross Priory PS	September	Risk based	2
Balbeuchley SR	November	Risk based	2
Muirhead SR	November	Action review	2

Image 11 New Water Pipes

3.2 Services and Benchmarking

Services

Following a number of audits in 2021 to look at tankering practices across Scotland, DWQR issued an Information Letter 01/2021 on the subject of 'The Augmentation of Drinking Water Supplies by Tanker' which set out the information that we require Scottish Water to record for their tankering activities.

Tankering is used across Scotland to maintain the water supply for a variety of reasons, including: where there are network bursts; where planned activity could interrupt the water supply, or; where the water supply in an area is struggling to cope with demand during dry weather. This brings added risk to the quality of the water supplied and it is important that Scottish Water carry out this work diligently and keep good records of this activity.

We audited the records kept by Scottish Water according to the Information Letter and found significant failings in their recording of information which showed a clear need for additional training. We recommended that Scottish Water take urgent steps to ensure all the required activity and associated information is captured, collated and stored for ease of retrieval and examination.

Table 7 Audit of services in 2022

Location	Date	Number of Recommendations
Tankering Operations	March	1
Dornoch Depot	March	2
Dundee Depot	May	3
Perth Depot	May	2
Galafoot (Galashiels) Depot	May	0
Intelligent Control Centre	September	3
Laboratory (sampling and analysis) - Edinburgh	November	5
Laboratory (sampling and analysis) - Inverness	December	2

In previous years DWQR's scrutiny and audit of Scientific Services has mostly concentrated on the laboratory services and for the first time in 2022 it has been widened to include sampling. The purpose of the audits was to examine the sampling procedures and practices undertaken at Scottish Water's depots.

The audits focused on criteria such as sample transportation, receipt and storage, staff training and the security of the site and samples. All staff involved had a good knowledge of procedures and the sites were well stocked and maintained.

Scottish Water has two UKAS-accredited laboratories. One based in Edinburgh and the other in Inverness. These laboratories undertake all sample examination and analysis for Scottish Water under specific Drinking Water Testing Specification (DWTS) accreditation. The laboratories also undertake sampling and analysis for

some local authorities and private contractors. DWQR audits the laboratories every two years (in addition to the audits undertaken by UKAS). Both laboratories were previously audited in 2019. Due to the Covid pandemic the 2021 audit was delayed until 2022, the findings of which are shown in Table 7. It was noted in the audits that both laboratories are well run and demonstrated good housekeeping. The staff were well trained and knowledgeable.

Image 12 Scottish Water's Inorganics Laboratory in Inverness

Image 13 Sample Bottle

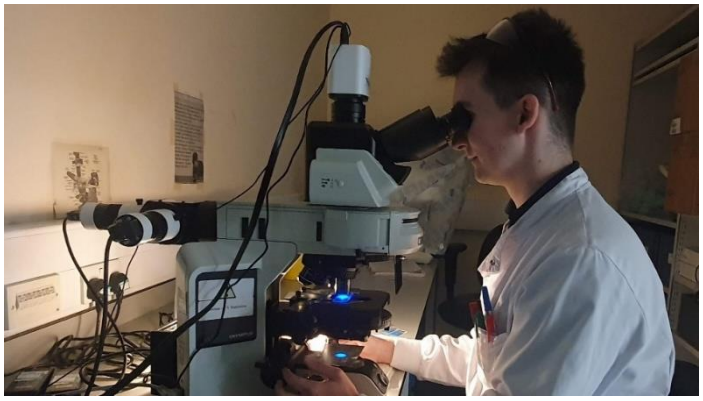


Image 14 Analyst viewing a *Cryptosporidium* slide in the Microscopy Laboratory in Inverness

Benchmarking

DWQR maintains close contact with the other water quality regulators in the UK and Europe to share knowledge, learning and best practice. These are excellent benchmarking opportunities: both to ensure DWQR inspectors are auditing to a high standard; and to make sure Scottish Water's standards for operations and procedures are of the same standard (or better) than other water providers.

During 2022 a Drinking Water Inspector from England accompanied our inspectors to audit boreholes at Moffat, Tomatin and Aviemore and share expertise. Both parties found the experience rewarding. We intend to continue these in future and DWQR has extended the invitation to more colleagues in England and Northern Ireland to accompany DWQR on benchmarking opportunities in Scotland during 2023.

Image 15 Borehole headworks

Image 16 Borehole pipework

Image 17 Borehole turbidity monitors

4. OTHER REGULATORY ACTIVITIES

In addition to the daily scrutiny of Scottish Water's activities, the DWQR team are involved in a range of activities, such as research and producing guidance for a national and international audience; and contributing to specialist groups on water quality. During 2022 the team participated in a number of academic and industry-led conferences. Of particular note was that one of our Specialists was part of the expert panel at the International Water Association (IWA)/WHO Conference on Water Safety Planning in Narvik, Norway.

We have been involved in a variety of projects – many still ongoing – in the following areas:

- Scottish Health Protection Network - Cyanobacteria guidance for inland and inshore waters;
- Cyanotoxins in Raw Waters – in depth research in cyanotoxins across the UK;
- Industry knowledge sharing and trials for reducing Lead exposure;
- Lead in Schools – Sampling programme and remedial actions undertaken by Scottish Water and Local Authorities to ensure schools and independent nurseries are free from Lead;
- Moredun Research Institute - Protozoan parasite research and technologies for rapid identification in drinking water; and,
- IWA - World Water Congress, Copenhagen – international conference for water professionals.

All our research work is published on our website at Completed Research Projects (dwqr.scot)

As part of our work at DWQR we feel it is important to educate wider stakeholders about the role we play in drinking water quality. We have team members serving on the boards of REHIS and the Institute of Water. During 2022 we gave talks or were involved with:

- University of West of Scotland – BSc Environmental Health;
- University of Edinburgh – MSc Hydrogeology;
- Clyde College – HNC Water Operations;
- Royal Environmental Health Institute of Scotland – Annual Environmental Health Forum;
- Scottish Water – various teams; and,
- Institute of Water – IWater Board, professional registration and CPD.

5. NETWORK INFRASTRUCTURE SECURITY DIRECTIVE

The Network Information Systems (NIS) Directive was introduced to improve the levels of cyber security and resilience of essential services across the EU. It provided the basis of NIS Regulations that were introduced in 2018. These regulations provide legal measures to protect essential services by improving the security of the network and information systems that support the delivery of these services. In line with the NIS Regulations, Scottish Water is identified as an 'Operator of Essential Services' as it supplies water to more than 200,000 people. The DWQR is identified as the relevant Competent Authority in Scotland.

The National Cyber Security Centre are the technical authority supporting both Operators of Essential Services and their competent authorities with cyber security advice and guidance. Further information is available at: NIS introduction - NCSC.GOV.UK.

In March 2022, Scottish Water submitted its NIS Improvement Plan to the DWQR which covers the period March 2022 – December 2024. This plan forms the basis of ongoing discussion and monitoring of progress

ANNEXES

Annex A

6.1 Information Letters issued during 2022

One Information Letter was issued by DWQR in 2022 and can be viewed on the DWQR website.

information-letter-1-2022-risk-assessment-and-sampling-of-poly-and-perfluorinated-alkyl-substances.pdf (dwqr.scot)

Annex B

6.2 Current Letters of Commitment and Enforcement Notices

Two Enforcement Notices were issued by DWQR in 2022 and can be viewed on the DWQR website.
Enforcement (dwqr.scot)

6.3 Abbreviations and Glossary

BH Borehole

Bq/l Becquerels per litre, a measure of radioactivity

CAF Cyber Assessment Framework

CWT Clear Water Tank

DCMS Department for Digital, Culture, Media and Sport

DOMS Distribution Operation and Maintenance Strategy

DWSP Drinking Water Safety Plan

DWQR Drinking Water Quality Regulator for Scotland

EAL Emergency Action Levels

IAF Impact assessment Form

ISO International Standards Organisation

mg/l milligrammes per litre

NCSC National Cyber Security Centre

NHS National Health Service

NIS Network Infrastructure Security

NRV Non-Return Valve

NSO Network Service Operator

NTU Nephelometric Turbidity Unit

PAC Powdered Activated Carbon

PCV Prescribed Concentration or Value

PHT Scottish Water's Public Health Team

PLC Programmable Logic Controller

RSZ Regulated Supply Zone

SCADA Supervisory Control and Data Acquisition

SEPA Scottish Environment Protection Agency

SR Service Reservoir

THM Trihalomethanes

TL Team Leader

TOMS Treatment Operation and Maintenance Strategy

TWS Treated Water Storage

µg/l microgrammes per litre

UV Ultraviolet Light

WTW Water Treatment Works

SUPPORTING INFORMATION

Water Performance Tables

Table 8 Summary of SW Assets 2022

Summary Asset Information	
Water Abstraction Points	672
Length of Water Mains (km)	48,640
Water Treatment Works	229
Storage Points	964
Water Supply Zones	281

Table 9 Summary of Water Quality at WTW

Parameter	Prescribed Concentration or Value (PCV)	No. of tests	No. of tests failing	% of tests failing	No. of WTW failing
Coliform bacteria	0 number/100ml	25285	18	0.071%	17
Colony counts after 3 days at 22°C	No abnormal change	21079	n/a	n/a	n/a
Colony counts after 48hrs at 37°C	No abnormal change	21148	n/a	n/a	n/a
Cryptosporidium	N/A - no regulatory standard	6277	19	0.303%	13
E. coli	0 number/100ml	25285	0	0.0	0
Nitrite	0.1mg NO_2/l	3201	0	0.0	0
Radon	N/A (100Bq/l parametric value)	39*	0	0.0	0
Residual disinfectant - free	N/A - no regulatory standard	25247	n/a	n/a	n/a
Residual disinfectant - total	N/A - no regulatory standard	25246	n/a	n/a	n/a
Turbidity	1NTU	6899	7	0.101%	3

* Counted for 56 water supply zone tests

Table 10 Summary of Water Quality at Storage Points

Parameter	Prescribed Concentration or Value (PCV)	No. of tests	No. of tests failing	% of tests failing	No. of SR failing
Coliform bacteria	0 number/100ml	48321	49	0.10%	49
Colony counts after 3 days at 22°C	No abnormal change	40417	n/a	n/a	n/a
Colony counts after 48hrs at 37°C	No abnormal change	40428	n/a	n/a	n/a
E. coli	0 number/100ml	48321	3	0.006%	3
Residual disinfectant - free	N/A - no regulatory standard	48296	n/a	n/a	n/a
Residual disinfectant - total	N/A - no regulatory standard	48291	n/a	n/a	n/a

Table 11 Water Quality at Consumers' Taps

Parameter	Prescribed Concentration or Value (PCV)	Total No. of Samples	No. Failed Samples	No. Zones with Failures		% Compliance in 2022	% Compliance in 2021	% Compliance in 2020
Key Parameters								
Bacteria								
Coliform Bacteria	0 number/100ml	14,806	38	29		99.74%	99.83	99.87
E. coli	0 number/100ml	14,806	4	4		99.97%	99.99	99.99
Clostridium perfringens	0 number/100ml	5,227	1	1		99.98%	99.94	100.00
Total Bacteria		*34,839*	*43*	*34*		*99.88%*	*99.91*	*99.94*
Metals								
Aluminium	200µg Al/l	5,222	1	1		99.98%	99.96	99.96
Copper	2mg Cu/l	1,452	1	1		99.93%	100.00	100.00
Iron	200µg Fe/l	5,222	29	21		99.44%	99.58	99.60
Lead	10µg Pb/l	1,151	6	6		99.48%	99.73	99.74
Manganese	50µg Mn/l	5,222	17	15		99.67%	99.37	99.71
Nickel	20µg Ni/l	1,452	1	1		99.93%	99.25	99.09
Total Metals		*19,721*	*55*	*45*		*99.72%*	*99.61*	*99.73*
Other key parameters								
Colour	20mg/l Pt/Co	5,235	0	0		100.00%	100.00	100.00
Hydrogen ion (pH)	6.5-9.5 pH	5,235	3	3		99.94%	99.96	99.98
Nitrite	0.5mg NO2/l	2,731	2	2		99.93%	99.96	100.00
Odour	Acceptable / No abnormal change	5,236	8	7		99.85%	100.00	100.00
Taste	Acceptable / No abnormal change	5,234	4	4		99.92%	100.00	100.00
Total Trihalomethanes	100µg/l	1,450	1	1		99.93%	99.86	99.93
Turbidity	4NTU	5,235	0	0		100.00%	100.00	99.98
Total Other Key Parameters		*30,356*	*18*	*17*		*99.94%*	*99.98*	*99.99*
Scotland total		**134,698**	**116**			**99.92%**	**99.92**	**99.95**

Table 11 Water Quality at Consumers' Taps (Continued)

Parameter	Prescribed Concentration or Value (PCV)	Total No. of Samples	No. Failed Samples	No. Zones with Failures		% Compliance in 2022	% Compliance in 2021	% Compliance in 2020
Other Parameters								
1,2 Dichloroethane	3µg/l	1,460	0	0		100.00%	100.00	100.00
Aldrin	0.1µg/l	0	0	0		N/A	N/A	N/A
Other Individual Pesticides	0.1µg/l	0	0	0		N/A	N/A	100.00
Ammonium	0.5mg NH4/l	5,235	0	0		100.00%	100.00	100.00
Antimony	5µg Sb/l	1,452	0	0		100.00%	100.00	100.00
Arsenic	10µg As/l	1,452	0	0		100.00%	100.00	100.00
Benzene	1µg/l	1,459	0	0		100.00%	100.00	100.00
Benzo 3,4 Pyrene	0.01µg/	1,452	0	0		100.00%	100.00	100.00
Boron	1mg B/l	1,452	0	0		100.00%	100.00	100.00
Bromate	10µg BrO3/l	1,451	0	0		100.00%	100.00	100.00
Cadmium	5µg Cd/l	1,452	0	0		100.00%	100.00	100.00
Chloride	250mg Cl/l	1,450	0	0		100.00%	100.00	100.00
Chromium	50µg Cr/l	1,452	0	0		100.00%	100.00	100.00
Conductivity	2500µS/cm at 20C	5,235	0	0		100.00%	100.00	100.00
Cyanide	50µg CN/l	1,451	0	0		100.00%	100.00	100.00
Dieldrin	0.1µg/l	0	0	0		N/A	N/A	N/A
Enterococci	0 number/100ml	1,452	0	0		100.00%	99.86	99.93
Fluoride	1.5mg F/l	1,450	0	0		100.00%	100.00	100.00
Gross alpha activity	0.1Bq/l	1,446	0	0		100.00%	100.00	100.00
Gross beta activity	1Bq/l	1,446	0	0		100.00%	100.00	100.00
Heptachlor	0.03µg/l	0	0	0		N/A	N/A	N/A
Heptachlor epoxide	0.1µg/l	0	0	0		N/A	N/A	N/A
Mercury	1µg Hg/l	1,448	0	0		100.00%	100.00	100.00
Nitrate	50mg NO3/l	2,730	0	0		100.00%	100.00	100.00
Nitrite/Nitrate formula	<1mg/l	2,730	0	0		100.00%	100.00	100.00
PAH - Sum of 4 Substances	0.1µg/l	1,443	0	0		100.00%	100.00	100.00
Pesticides - Total Substances	0.5µg/l	1,046	0	0		100.00%	100.00	100.00
Selenium	10µg Se/l	1,452	0	0		100.00%	100.00	100.00
Sodium	200mg Na/l	1,452	0	0		100.00%	100.00	100.00
Sulphate	250mg SO4/l	1,411	0	0		100.00%	100.00	100.00
Tetrachloroethene/ Trichloroethene	10µg/l	0	0	0		N/A	100.00	100.00
Tetrachloromethane	3µg/l	1,450	0	0		100.00%	100.00	100.00
Total other parameters		*49,820*	*0*	*0*		*100.00%*	*100.00*	*100.00*
Scotland total		**139,971**	**116**			**99.92%**	**99.92**	**99.95**

*

Gross alpha and gross beta activity are not included in the Total other parameters or Scotland total figures and are not used to calculate the total compliance figure. This is because there is no PCV value for these variables. They form part of a monitoring program to detect any radionuclides in accordance with The Public Water Supplies (Scotland) Amendment Regulations 2017. The total number of samples including monitoring for radon, which is taken at WTW final water but applied across Water Supply Zones. ** A supply zone can fail for more than one parameter. This means that the total number of zones that failed for at least one parameter is less than the sum of the No. Zones with Failures column

Table 12 Water Quality Consumer Contacts Received by Scottish Water

Contact Category	Number of Contacts				% Change on 2021	Contact rate per 10,000 population	
	2022	2021	2020	2019		2022	2021
Appearance							
Discoloured Water	**12,251**	17,887	12,989	6,623	-32%	**22.4**	32.7
Aerated (Milky) Water	**1563**	1,662	1,660	882	-6%	**2.9**	3.0
Particles in Water	**469**	543	553	365	-14%	**0.9**	1.0
Organisms in Water	**32**	30	40	33	7%	**0.1**	0.1
Taste and Odour							
Chlorine	**522**	731	985	578	-29%	**1.0**	1.3
Metallic	**347**	602	356	358	-42%	**0.6**	1.1
Solvent/Fuel Taste/Smell	**13**	14	31	21	-7%	**0.0**	0.0
Musty/Earthy	**725**	1,058	621	639	-31%	**1.3**	1.9
TCP/Chemical Taste/Smell	**381**	505	525	302	-25%	**0.7**	0.9
Other Water Quality Contact							
Illness due to Water	**315**	733	286	240	-57%	**0.6**	1.3
Other Contact	**0**	5	96	617	-100%	**0.0**	0.0
Total Contacts about Water Quality	**16,618**	23,770	18,142	10,124	-30%	**30.4**	43.5

7.2 SUMMARY OF EVENTS AND INCIDENTS 2022

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.

The following tables detail the significant, serious and major events declared as incidents. A summary of each individual incident assessment can be viewed on the DWQR website: [2022 Incidents (dwqr.scot)]

Table 13 Classification of Incidents

Category	Not Significant or Minor	Significant	Serious	Major
	789	**23**	**3**	**0**

Table 14 Summary of 2022 Incidents

Area	Event Date	Classification	Population Affected	Asset Type	Site name	Location	Hazard	Root Cause
South	20/01/2022	Significant	20,486	Storage Point	Legbrannock SR	Central Scotland	Taste and Odour	Disinfectant Outwith Specification
South	11/02/2022	Significant	11,741	Treatment Works	Lochinvar WTW	Dumfries and Galloway	pH	Incorrect Dose
South	16/02/2022	Significant	2,310	Treatment Works	Cargen WTW	Dumfries and Galloway	Microbiology	Disinfectant Dosing Failure
East	23/03/2022	Significant	14	Treatment Works	Papa Stour WTW	Shetland	THM	Inadequate Treatment
East	06/04/2022	Significant	23,539	Water Supply Zone	Perth	Perth and Kinross	Discolouration	Flow Disturbance (3rd Party)
East	15/04/2022	Significant	3,762	Water Supply Zone	Turret B	Central Scotland	Manganese	Burst Main Disturbance
South	25/04/2022	Significant	15,616	Water Supply Zone	Balmore E	Central Scotland	Discolouration	Burst Main Disturbance
North	06/05/2022	Serious	360	Treatment Works	Lochinver WTW	Highland	Turbidity	Deposits in Limestone Contactor
East	08/05/2022	Significant	12,698	Water Supply Zone	Glenfarg Kinesswood B/H	Fife	Discolouration	Burst Main Disturbance
East	23/05/2022	Significant	3,485	Water Supply Zone	Lintrathen	Angus	Discolouration	Flow Disturbance (Scottish Water)
South	28/06/2022	Significant	36,675	Storage Point	Garbethill SR	Central Scotland	Discolouration	Pipeline Deposits
North	12/07/2022	Significant	2,227	Treatment Works	Torra WTW	Islay	Aluminium	Coagulant Aid Failure
West	20/07/2022	Significant	81,840	Water Supply Zone	Carron Valley B	Central Scotland	Taste / Odour	Inadequate Treatment
West	09/08/2022	Significant	813	Treatment Works	Killin WTW	Perthshire	Manganese	Disturbance of Deposits
North	14/08/2022	Significant	809	Treatment Works	Port Charlotte WTW	Islay	Manganese	Filter Bed Efficiency
West	01/09/2022	Significant	6,806	Storage Point	Kerse SR	Ayrshire	Microbiology	Asset Integrity
South	06/09/2022	Significant	75	Treatment Works	Carsphairn WTW	Dumfries and Galloway	Microbiology	Membrane Integrity Lost
East	09/09/2022	Significant	98,005	Treatment Works	Lintrathen WTW	Angus	Cryptosporidium	Filter Bed Efficiency
East	02/10/2022	Significant	30,197	Treatment Works	Forehill WTW	Aberdeenshire	Microbiology	Chemcial Tank Empty or Low
West	05/10/2022	Significant	51,343	Treatment Works	Burncrooks WTW	Dunbartonshire	Microbiology	Incorrect Dose
North	18/10/2022	Significant	270	Treatment Works	Achiltibuie WTW	Highland	Cryptosporidium	Membrane Integrity Lost
West	29/10/2022	Significant	4,762	Water Supply Zone	Afton WTW	Ayrshire	Discolouration	Burst Main Disturbance
West	01/11/2022	Serious	4,711	Storage Point	Darvel SR	Ayrshire	Microbiology	Asset Integrity
North	30/11/2022	Significant	43	Treatment Works	Arnisdale WTW	Highlands	Cryptosporidium	Inadequate Treatment
East	02/12/2022	Significant	329,065	Treatment Works	Mannofield WTW	Highland	Cryptosporidium	Inadequate Treatment
West	24/12/2022	Serious	35,500	Treatment Works	Picketlaw WTW	Renfrewshire	Microbiology	Incorrect Dose

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