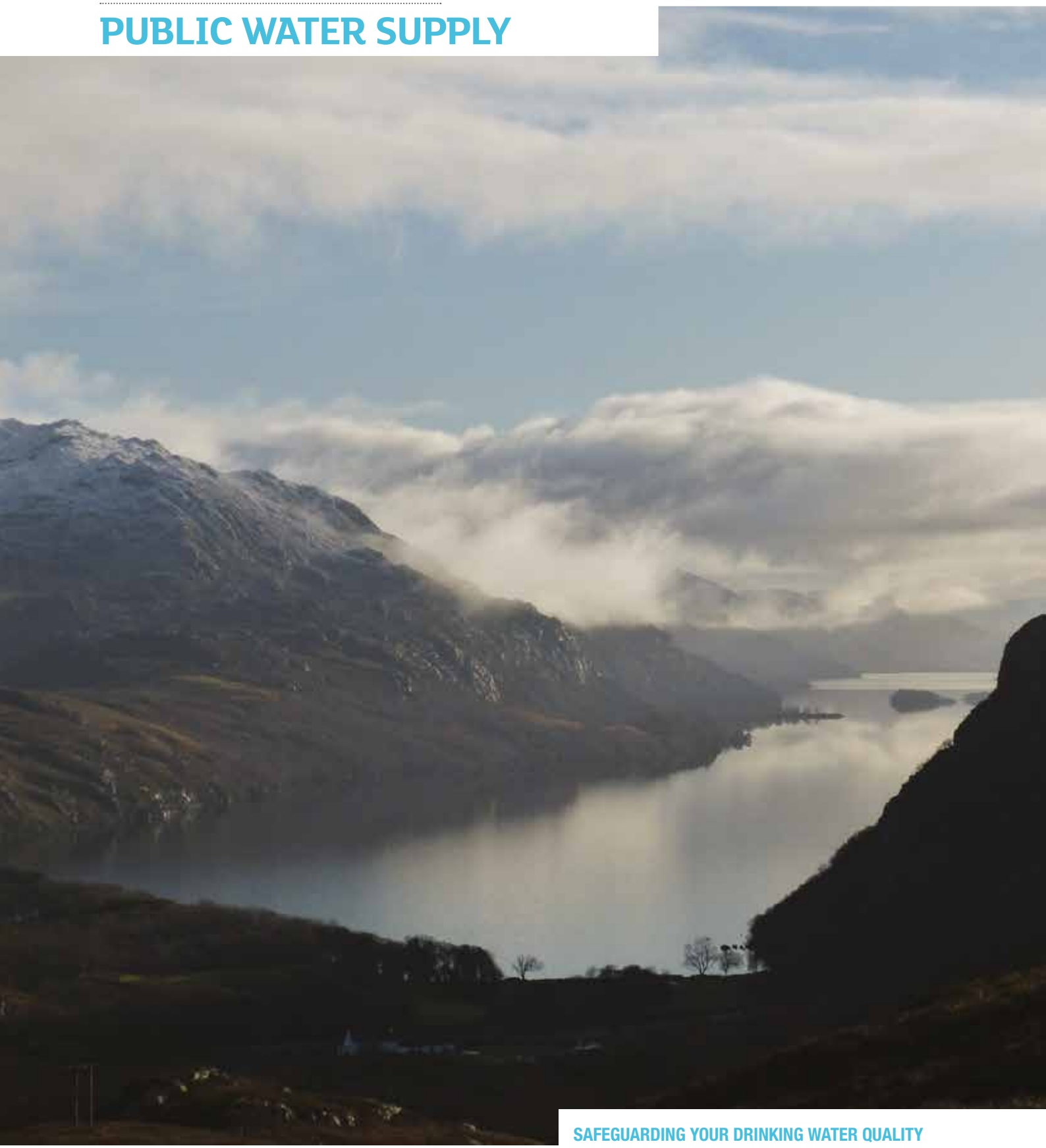
Drinking Water Quality Regulator for Scotland

DRINKING WATER QUALITY IN SCOTLAND 2014

PUBLIC WATER SUPPLY



SAFEGUARDING YOUR DRINKING WATER QUALITY

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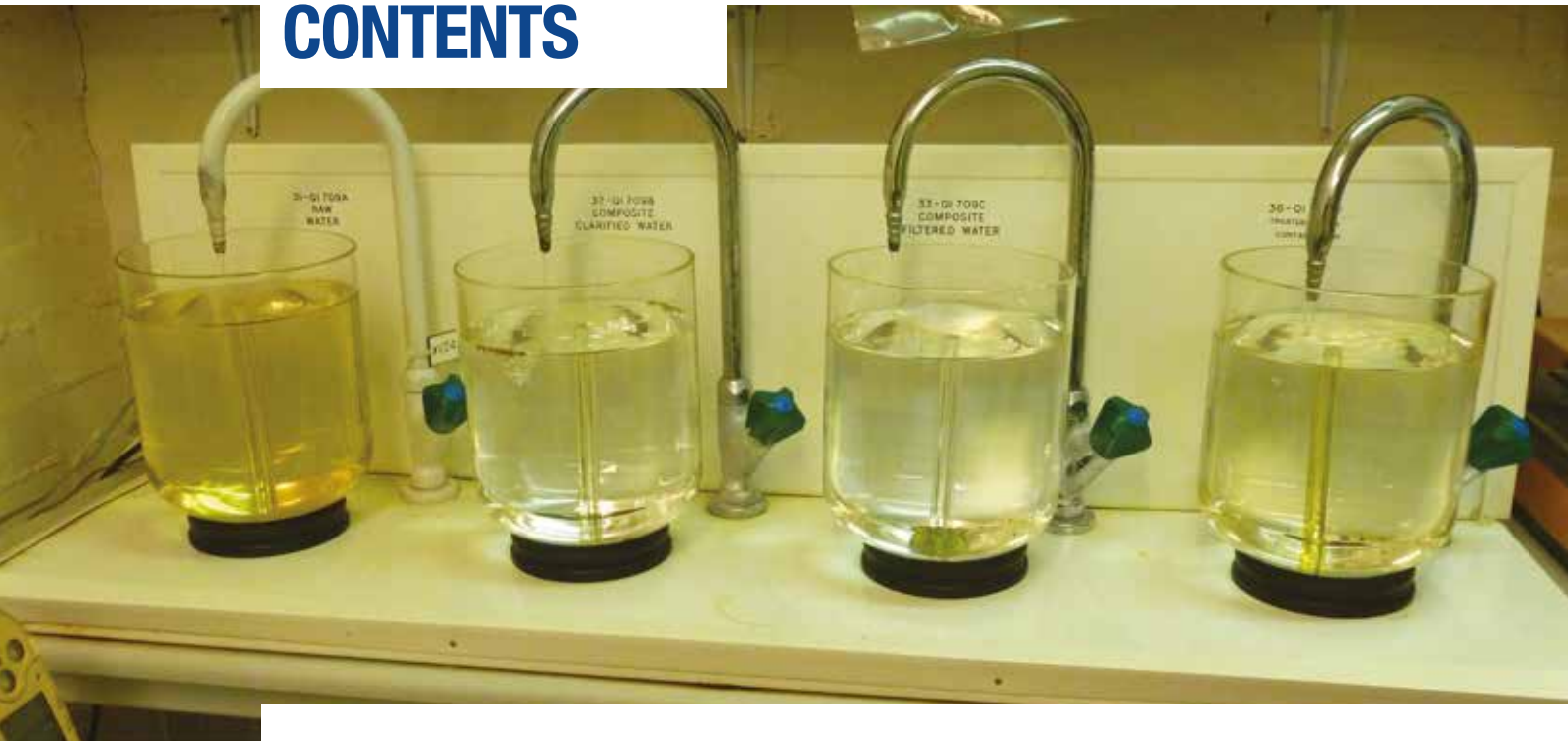
CONTENTS



FOREWORD

This report describes both the quality of water supplied by Scottish Water during 2014 and the work of the Drinking Water Quality Regulator for Scotland (DWQR) in ensuring relevant standards are achieved. This is the thirteenth report of the DWQR since Scottish Water was created in 2002.

Drinking water quality is measured by testing for a range of parameters in water samples collected at water treatment works, storage points and consumers' taps. The standards these tests should meet are set out in the Water Supply (Water Quality) (Scotland) Regulations 2001, and are largely derived from the European Drinking Water Directive. Scottish Water undertakes its own sampling and testing, under a stringent accreditation system, and reports to DWQR.

The majority of all samples tested do meet the required standard confirming that the quality of public water supplies in Scotland remains at a very high level. Compliance with standards for samples collected from consumers' taps in 2014 was 99.89%. This is the same overall compliance as for 2013 with some improvements, and deterioration, of individual parameters.

An important area of testing is for microbiological parameters and the monitoring results for these parameters has shown a deterioration throughout the water supply system. The main tests in this area are for the indicator organisms of coliforms and *E. coli*. There are more than double the number of coliform failures at treatment works in 2014 than for 2013. I am disappointed to have to report this position and have requested that Scottish Water examine disinfection processes, in detail, at all of its treatment works.

Three metal parameters: aluminium, iron and manganese, are important measures for monitoring the condition of the extensive pipe network required to transport water from the treatment works to the point where it is made available to consumers. I am pleased to report significant improvement in compliance for these parameters. Scottish Water has made substantial investment in its pipe network since it was formed and made improvements in how it is managed, maintained, monitored and controlled. In particular, improved understanding of network characteristics allows better decisions to be made in planning operational activities. The level of improvement in compliance for these parameters should lead to reduced incidence of discoloured water and consumer complaints, though this was not demonstrated in 2014, I look forward to an improving trend in future years.

Scottish Water has reported a higher number of water quality incidents to DWQR during 2014 when compared to 2013. When incidents occur it is often due to a set of circumstances that results in the failure of one, or more, assets in the supply system. The high number of reported incidents this year reinforces the need to design, build, maintain and operate resilient assets, that can cope with the various challenges that should be identified through robust water safety planning. Once Scottish Water identified a problem, the operational response was generally appropriate in ensuring remedial action was taken. However, I remain concerned at the continued failure to take appropriate samples for analysis in investigating incidents to determine the extent and duration of any problem, the potential impact on consumers and, ultimately, to determine when water quality has been restored once the incident is over. Scottish Water has given reassurance that this will be remedied and I will monitor incident responses during 2015 to ensure improvement in this area.

Scottish Water continues to make significant investment in improving water quality across Scotland. Timely investment is important in addressing risks and I am concerned with the number of improvement schemes that failed to meet original completion dates in 2014. I am content that Scottish Water has, where necessary, put in place temporary measures to improve water quality and has made substantial changes to the delivery model for the new investment period for 2015-2021.

DWQR also provides a second tier complaint investigation service, for water quality complaints, to enable consumers who have not had an acceptable resolution through the usual complaints process operated by Scottish Water. Very few such complaints are escalated to DWQR and I commend Scottish Water for their focus on consumer satisfaction.

In 2014, the overall compliance for drinking water quality has been maintained at a very high level and the people of Scotland continue to receive a high quality service from Scottish Water. There continue to be challenges to be resolved and the need for thorough risk assessment and diligent operation of resilient water supply systems is ever present. I support the significant investment Scottish Water continues to make in improving water quality and look forward to ongoing dialogue in ensuring the delivery of timely solutions.

Sue Petch
Drinking Water Quality Regulator
for Scotland

EXECUTIVE SUMMARY

The Drinking Water Quality Regulator for Scotland (DWQR) regulates the quality of water supplied by Scottish Water and has a role to ensure that local authorities are meeting their responsibilities to regulate the quality of private water supplies. The role of DWQR was created by the Water Industry (Scotland) Act 2002 ('the Act'), which gives the Regulator various powers to enter premises as part of an investigation, to obtain information and to take enforcement action. This report fulfils the requirement under the Act that the DWQR publishes a report on the exercise of the Regulator's functions during the previous year. This report relates to the calendar year 2014.

The quality standards that drinking water supplies must meet are set out in regulations and the function of DWQR is to ensure that these regulations are complied with. In Scotland the regulations relating to the quality of water supplied by Scottish Water during 2014 are The Water Supply (Water Quality) (Scotland) Regulations 2001. Private water supplies have equivalent regulations – The Private Water Supply (Scotland) Regulations 2006 – which are enforced by local authorities. Quality Standards in both regulations are derived from the European Drinking Water Directive 98/83/EC.

In Scotland the water supplier, Scottish Water, takes and analyses its own samples to demonstrate that the water supplied complies with regulatory requirements. This is consistent with water industry practice in the rest of the UK. The DWQR checks that this has been done correctly and monitors the results. DWQR also inspects a range of Scottish Water activities that could affect quality and investigates any water quality incidents that are reported.

Drinking water in Scotland comes from a number of sources. All supplies need to be treated before they are of satisfactory quality to be drunk by consumers. The extent and type of treatment required depends on the nature of the supply, its quality and any potential risks to quality that are present. All water in Scotland supplied by Scottish Water is disinfected. This usually involves adding a tightly controlled amount of chlorine to the water in order to make it safe. Summary facts about the public water supply in Scotland are shown below:

197 Loch and Reservoir Sources

176 River Sources

178 Spring and Borehole Sources

47,000km Water Mains

242 Water Treatment Works

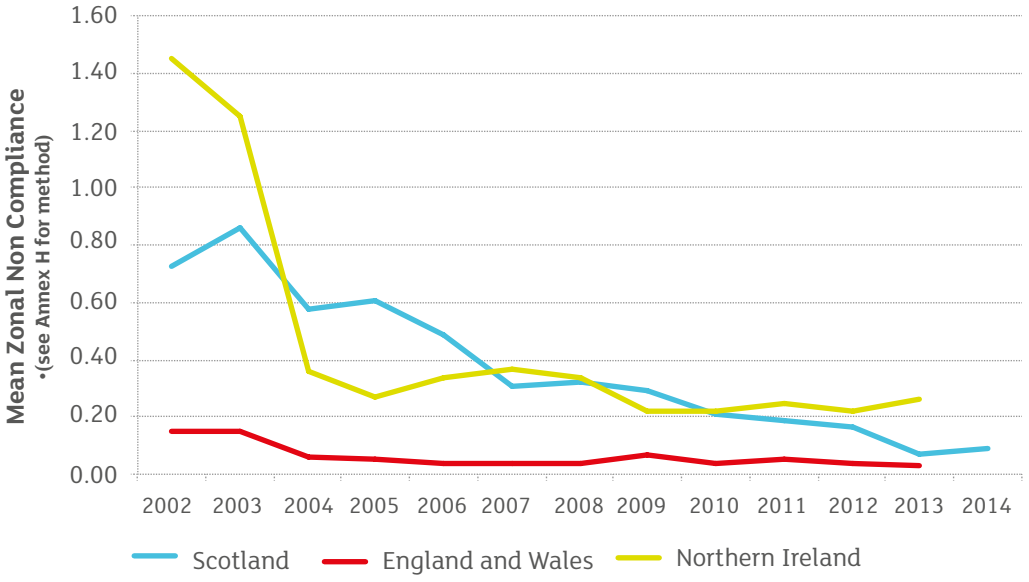
994 Storage Points

COMPLIANCE WITH THE STANDARDS – HOW GOOD WAS DRINKING WATER IN 2014?

Scottish Water carried out 318,611 regulatory tests for which there is a numerical standard on Scotland's drinking water in 2014 and many more for operational purposes. Some of these tests were on samples taken from water as it leaves treatment works and storage points. The largest number of samples was collected from randomly selected consumers' taps across the country, and this is where compliance is generally measured as it is the point at which users consume the water.

In 2014, 151,714 tests were carried out on samples collected from consumers' taps and 99.89% of these complied with the parameters for which there is a numerical standard, demonstrating that improvements previously delivered have been sustained.

A useful measure of drinking water quality which allows direct comparison with England, Wales and Northern Ireland is to consider the performance using Mean Zonal Compliance, and the comparative chart is shown below.

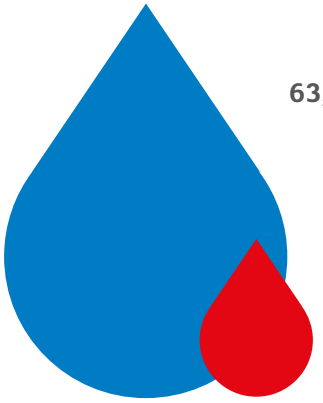


WATER QUALITY AT TREATMENT WORKS

The 242 water treatment works (WTW) around Scotland vary considerably in size, but all are sampled regularly. In 2014, 63,858 tests were carried out on samples collected at treatment works. The main compliance parameters are microbiological – coliforms and *E. coli* – and these provide an important check that disinfection has been effective.

Of the tests undertaken in 2014, 40 contained coliform bacteria and two contained *E. coli*. DWQR is disappointed with the deterioration in compliance for these parameters when compared to 2013. While slightly fewer samples were taken in 2014, there were more than twice as many failures of the coliform bacteria standard, than in 2013.

Cryptosporidium is a microscopic organism that can be present in untreated water contaminated by faecal material and it is therefore extremely important that the treatment processes used by Scottish Water provide a robust and effective removal mechanism. Scottish Ministers require Scottish Water to sample supplies and test for *Cryptosporidium* oocysts in all supplies at a frequency that depends on risk. Out of 8,851 samples taken from 242 treatment works in 2014, 124 (1.40% of samples) contained oocysts, a slight improvement from the previous year, and the third consecutive improvement in three years. However, the number of treatment works from which at least one positive sample was taken was 51 in 2014, higher than the 43 from 2013. A number of the sites recording detections had a membrane treatment process which should be providing an effective barrier to *Cryptosporidium*, Scottish Water have been carrying out detailed investigations to determine the reasons for this and identify the necessary remedial actions.



63,858 tests at WTW

42 tests failed

WATER QUALITY IN DISTRIBUTION SYSTEMS

The distribution system comprises the network of pipes delivering water to homes and businesses as well as any storage points such as water towers and service reservoirs. Scottish Water has just under a thousand storage points and more than 47,000km of water mains and it must ensure that the condition of these does not cause water quality to deteriorate.

Scottish Water must sample each storage point weekly and test for *E. coli* and coliform bacteria. According to the Regulations, 5% of samples from a storage point may contain coliforms before it is considered to have failed to meet the standard, however, DWQR expects all detections to be investigated and any remedial action necessary to prevent recurrence is implemented. In 2014, two samples contained *E. coli* which is a continued improving trend and one storage point failed to meet the regulatory requirement that 95% of samples shall not contain coliforms. The number of samples which contained coliforms is greater than that reported in 2013, and demonstrates that despite Scottish Water's improvement of both investigation of failures at storage points and improvements to the assets and to working practices, there remains much to do.

Although they are measured at consumer's taps, iron and manganese compliance provides an indication of the condition of the distribution system and any deposits within it. Both substances can cause discolouration that can greatly inconvenience consumers and lead to complaints. DWQR is pleased to report that in 2014, compliance for iron and manganese has shown a significant improvement compared to previous years with the number of failures reducing from 60 to 35. Scottish Water's work to improve their understanding of the cleanliness of distribution systems and provide an evidence-based approach to planned preventative maintenance has undoubtedly helped the position.

Greenock supply zone in the West recorded the greatest number of failures for these parameters with three failures of the standard for iron. A significant amount of rehabilitation work has already been undertaken in this zone over the years, but it is apparent that further work in the area is likely to be required.

WATER QUALITY AT CONSUMERS' TAPS

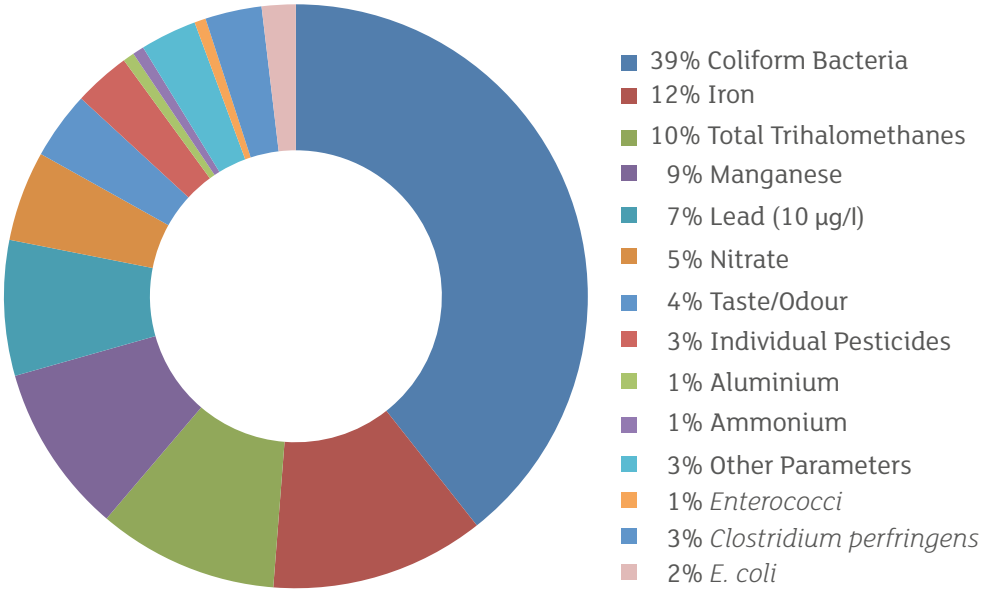
Most samples to assess regulatory compliance are taken from consumer taps, and testing takes place for 51 parameters. Sampling frequencies are determined by the size of the population in the water supply zone. The vast majority of samples that were taken fully complied with regulatory requirements, though 160 did not meet the required standard.

For microbiological parameters, two samples contained *E. coli:* an improvement on 2013. The number of samples which contained coliforms has increased from the results recorded in 2013. The majority of these were for single coliforms, with no discernible pattern across the water supply zones. The reasons for the presence of coliforms can be complex, influenced by the integrity of the network, temperature, residual chlorine, pipework and storage arrangements within buildings. Scottish Water investigates all failures in order to understand the factors which may have caused the result and assess what, if any, remedial action is taken.

The chemical parameters with the poorest percentage compliance were total trihalomethanes (98.95%), iron (99.63%), lead (99.20%) and manganese (99.70%), though iron and manganese show a significant improvement on last year. The regulatory standard for lead was reduced from 25 micrograms per litre to 10 at the start of the year, so some deterioration in performance was expected though this has not been as significant as anticipated.

The step change seen in 2013 in improving trihalomethane (THM) compliance has generally been maintained with the number of samples not meeting the standard being only slightly poorer than in 2013, mainly due to failures at Tullich supply zone in the Oban area. The treatment process here is being upgraded with completion scheduled for September 2017, although operational improvements are expected to be implemented in advance of that date. Scottish Water have employed a range of techniques to improve organics removal at treatment works and reduce THM formation in distribution systems. This work is demonstrating a clear benefit and is welcomed.

Sample failures at consumers' taps



The chart shows the proportion of parameter failures against the overall total.

Drinking water quality compliance samples are taken from consumers' taps, generally the kitchen tap within a property. For some parameters such as coliforms, lead and nickel, the domestic distribution system within the property can impact on the quality and the taste of drinking water at the tap. To help consumers understand these issues the water industry has produced a simple guide which provides tips on water quality within the home. The guide can be found on the Water UK website using this link: http://www.water.org.uk/news-water-uk/looking-after-water-your-home.

EVENTS AND INCIDENTS

Very occasionally things go wrong, and Scottish Water is required to tell DWQR about all events that could adversely affect water quality or cause concern to consumers. In 2014, 758 such events were notified to DWQR, a significant increase when compared to 2013, although slight modifications were made to the criteria for notification. DWQR considers each event and classifies them into one of five categories. Those events which are assessed as serious, significant or major are declared incidents and may require a full report from Scottish Water. DWQR investigates incidents and produces a written assessment, making recommendations where appropriate. Incident assessments are published on the DWQR website. In 2014, 53 events were classified as incidents, representing an increase when compared to previous years.

Failure of the coagulation stage of the treatment process was the largest single cause of incidents in 2014, with the East and West areas of Scottish Water being particularly prone to these. The coagulation and clarification stages are vital in removing particulate matter from the water, including *Cryptosporidium*, and DWQR has urged Scottish Water to improve process resilience in this area.

Notable Incidents during 2014 include:

- **Lochenkit WTW, Dumfries and Galloway – Disinfection Failure – June 2014**
  Following a power cut, delays in the changeover of power from a temporary generator back to mains power led to an airlock in the chlorine disinfection system. There were issues with the manufacturer's calibration procedure for the chlorine monitoring system, but also problems with flow to the chlorine monitors. Undisinfected water was supplied to the public for over nine hours. DWQR was highly critical of the lack of sampling in response to this incident, as no appropriate samples were taken to determine the quality of the water supplied to consumers. DWQR was also concerned about the lack of robustness surrounding the chlorine dosing and monitoring at the site. DWQR made eight recommendations to Scottish Water for improvements.

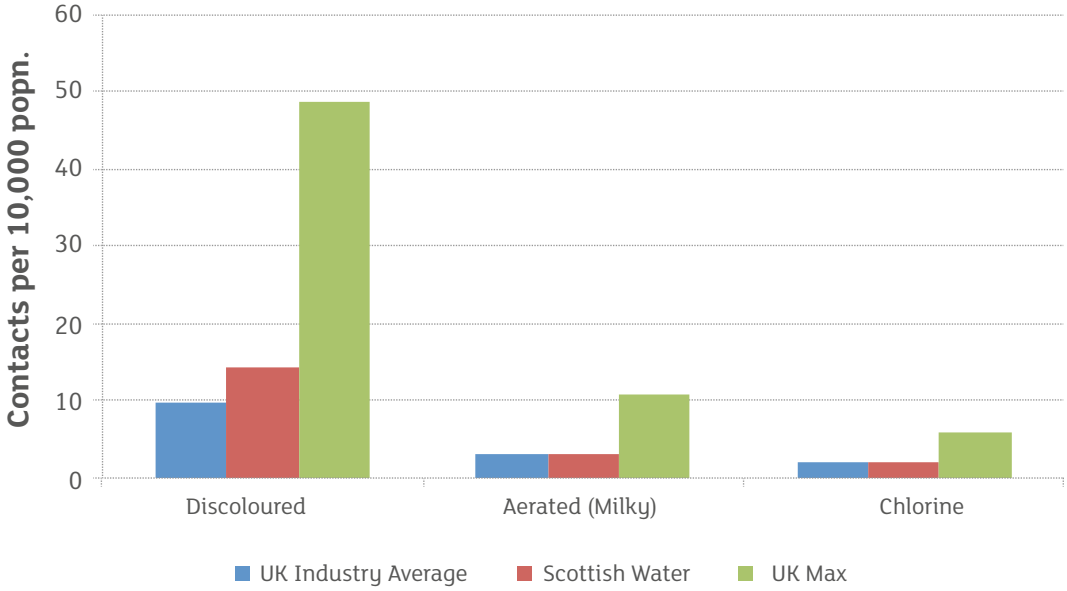
- **Savalbeg WTW, Lairg – Elevated Aluminium – April 2014**
  Scottish Water set up a trial to use an alternative flocculant in an attempt to improve the performance and potentially increase the throughput of the treatment works. Despite no plant operators being on site, process scientists proceeded with the trial. During the changeover of the flocculant, aluminium levels rose rapidly and the trial was abandoned. Attempts to run the works to waste failed, and the concentration of aluminium in the final water exceeded regulatory standards. The trial commenced again the next day, this time with the site operators present, but without any tests or investigations into the cause of the previous days issues. Again, the incorrect dose of chemical was used and aluminium levels exceeded regulatory standards, resulting in blocked filter media. DWQR was highly critical of the trial taking place without the presence of trained plant operators on the site on the first day, and the second trial having been attempted without understanding the cause of the issues on the first day of the trial work.

- **Rosemarkie SR, nr Fortrose – Microbiological Failure – May 2014**
  A third party JCB driver caused a burst on the outlet main from Rosemarkie service reservoir, with the damage occurring in a cattle field. Scottish Water Operations were alerted and shut down the main which was promptly repaired and recharged. Six days after the repair a sample was taken from the sample tap at Rosemarkie service reservoir (downstream of the repair) which contained coliforms. Several other samples taken at this time also contained coliforms. A 'boil water' notice was issued by Scottish Water to approx. 550 residents downstream of the failing sample. This was lifted two days later following several sets of satisfactory samples. DWQR was critical of Scottish Water's failure to follow their own mains repair procedures, which, compounded by poor sampling, led to this incident and left consumers unable to drink their supply without first boiling it.

CONSUMER CONTACTS

Scottish Water had 14,012 consumer contacts relating to water quality equating to a contact rate of 27.7 per 10,000 population. This is a disappointing increase over the position in 2013 and it is driven by more consumer calls concerning discolouration of the water supply. Other categories are substantially of the same order as last year. It is good to see the upward trend in taste and odour complaints appears to have stabilised and is again in line with earlier years' experiences. Again this year, over 40% of all taste and odour complaints are about chlorine – the level of complaints is two per 10,000, and this is the lowest seen over the past eight years.

Consumer contacts to Scottish Water about quality against UK baseline



AUDIT AND INSPECTION

Audit and Inspection is a key part of DWQR's role and DWQR undertakes a number of inspections across Scotland every year, auditing against regulatory requirements and industry best practice. This enables DWQR to monitor and assess Scottish Water's performance against best practice as well as comparing practices in different parts of Scotland. Where deficiencies are noted, DWQR makes recommendations, the resolution of which is tracked. Elements of best practice are also noted. In 2014 DWQR undertook the following inspections:

- 4 Water treatment works
- 1 Treated water storage point
- 1 Network
- 5 Investment schemes

The treatment works inspections demonstrated that treatment processes were generally being run effectively by highly competent staff. A number of issues were identified, and more commonly occurring themes included the online monitoring of water quality, SCADA systems, and identification of risk.

22 recommendations were made by DWQR during inspections in 2014.

SECTION 1 WATER QUALITY AT TREATMENT WORKS

Scottish Water has 242 water treatment works (WTW) that treat water to ensure it is safe to drink and complies with the standards set out in the Regulations. Treatment works in Scotland range from large supplies serving whole cities to very small plants that supply small communities consisting of a few properties. Regardless of size, Scottish Water is expected to ensure that its works are capable of treating the range of raw water quality which may be found in source waters.

Scottish Water uses drinking water safety plans to assess risks to raw water quality and the ability of treatment works to deal with these. Where risks are identified that are not adequately addressed by the current treatment process, Scottish Water will decide how these risks are best managed. This may involve promoting the site for capital investment, or addressing the risks via operational means.

All natural water requires treatment, including disinfection, before it can be considered safe to drink. It is vital that water is thoroughly treated first in order for the disinfection process to be effective. In order to prepare water for disinfection, particulate material needs to be removed along with naturally occurring organic compounds in the water. These include the compounds that cause water to be coloured and can react with chlorine to form trihalomethanes (THMs) later in the process. Treatment of drinking water can vary, but commonly consists of a flocculation stage to collect particulate material together, followed by a clarification stage such as sedimentation or floatation. Water is then filtered to remove any remaining particulate and coagulant material to ensure that water is as clean as possible prior to disinfection with chlorine.

The majority of regulatory analysis takes place on samples collected from consumers' taps, but some important sampling also takes place on water as it leaves each treatment works. The number of samples which need to be collected each year varies depending on the volume of water supplied by the treatment works.

1.1_ MICROBIOLOGICAL QUALITY AT TREATMENT WORKS

Disinfection is used to remove or inactivate pathogens from the water so that it is safe to drink. The addition of chlorine, or compounds based on chlorine, are effective means of achieving disinfection and have been used for this purpose in drinking water for over 100 years. Scottish Water is expected to add sufficient chlorine to kill pathogens and leave a small residual amount to keep the water safe as it travels through distribution pipework to consumers. Although it is normal for consumers to be able to detect a slight taste and smell of chlorine in water from their taps, Scottish Water needs to control chlorine concentrations carefully to ensure that no more is used than necessary.

Coliforms and *E. coli* are two parameters measured in water leaving treatment works in order to verify that disinfection has been successful. Coliforms are a group of bacteria, of which *E. coli* is one species, that are found commonly in the environment. Not all coliform bacteria cause illness, but the coliform parameter is used as an indicator in the demonstration that disinfection has been successful and that water has not become contaminated after treatment. While some detections of coliforms may be due to issues associated with sampling, all failures must be fully investigated by Scottish Water and reported to DWQR, the local NHS board and local authority. *E. coli* is detected much less frequently than coliform bacteria, however this organism does have the potential to cause illness as it originates from faecal material, indicating the possibility of serious contamination that must be investigated immediately and the risk to consumers assessed and mitigated.

When investigating sample failures at treatment works, Scottish Water should be considering a number of factors, such as changes in the quality of the incoming raw water, issues or unexpected changes in the treatment process, the circumstances of sampling, including the condition of the sample line and sample tap, and evidence from samples taken downstream in the distribution system. Consideration should be given to taking additional samples, including between stages of the treatment process, to establish whether there is a genuine problem and where this might be. Data from on-line monitoring can also yield very useful information on quality around the time of the failure. Scottish Water routinely carries out root cause analysis of sample failures and this has been beneficial in understanding and resolving the causes underlying many failures.

Colony counts are also monitored at water treatment works. Although there is no numerical standard for these, they are a useful indicator of microbiological activity, and again can provide a measure of the effectiveness of the disinfection process, especially when trended over time.

Table 1.1_ Summary of microbiological tests at treatment works

COLIFORM BACTERIA	2014	2013	2012	2011	2010	2009	2008
Number of tests	26,814	26,888	27,305	28,792	29,097	30,997	31,488
Number containing coliforms	40	17	33	49	44	30	76
Percentage containing coliforms	0.15	0.06	0.12	0.17	0.15	0.10	0.24
E. coli							
Number of tests	26,814	26,888	27,304	28,794	29,097	30,997	31,487
Number containing *E. coli*	2	1	3	5	8	6	10
Percentage containing *E. coli*	0.01	0.00	0.01	0.02	0.03	0.02	0.03

Table 1.1 and **Figure 1.1** show the microbiological results at treatment works for recent years. Of the 26,814 samples taken, 40 contained coliform bacteria and two contained *E. coli.* DWQR is disappointed with the deterioration in compliance when compared to 2013; while slightly fewer samples were taken in 2014, there were more than twice as many failures of the coliform bacteria standard. While most coliform bacteria failures occurred only once at a treatment works in 2014, a number of works had multiple failures of the standard. Mannofield WTW in Aberdeen had four coliform bacteria failures in 2014; two were attributed to problems with the coagulation process, one to analytical error and for one, no cause for the failure could be determined. Black Esk, Forehill, Perth and Tobermory WTWs each had two failures in 2014. The *E. coli* failures were from Mannofield and Perth WTW. Both were single *E. coli* detections, and neither failure could be explained by Scottish Water. DWQR will be monitoring performance very closely and if necessary will consider the need for regulatory intervention.

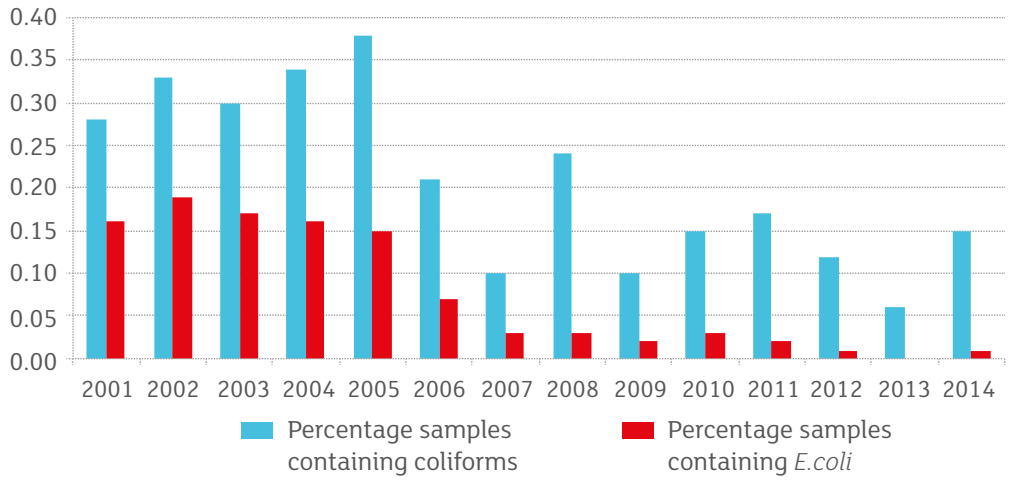


Fig 1.1_ Tests failing microbiological standards

Most of the coliform detections involved a single coliform, although Applecross WTW had a failure with 28 coliform bacteria. This failure was subsequently found to have been related to a faulty sample line. Black Esk WTW had a failure with three coliform bacteria, as well as a failure with one coliform bacterium. Both failures were attributed by Scottish Water as being caused by infiltration into storage points at the treatment works, which have since been resolved. Forehill WTW had two failures of the coliform standard. The cause of one of the failures was unknown, and the other failure was reported as likely caused by contamination at the laboratory.

Although Scottish Water has made considerable progress in improving the efficacy and resilience of its disinfection process in the 13 years since it was formed, it is clear that there is no room for complacency. DWQR has requested that Scottish Water prepares Disinfection Strategies for each water supply, documenting operation and control of the disinfection process and identifying any risks and how they will be addressed. The supplies that Scottish Water considers to be highest risk must be covered by Disinfection Strategies by the end of 2015, and DWQR will be inspecting these carefully. Once completed, the strategies should provide an ongoing record of how each supply system should be operated in order to ensure the microbiological safety of the water and identify any investment requirements and will be subject to audit by DWQR.


Clarifiers at Afton WTW, Ayrshire

1.2_ CHEMICAL QUALITY AT TREATMENT WORKS

Water is tested for two chemical parameters, nitrite and turbidity, in samples taken from treatment works. These are summarised in **Tables 1.2a** and **1.2b**. 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 controlled as it should be. For the third year running no exceedences of the standard for nitrite were recorded at water treatment works: the outcome of Scottish Water's efforts to actively control the chloramination process.

Table 1.2a_ Summary of nitrite tests on samples taken at water treatment works

NITRITE	2014	2013	2012	2011	2010	2009	2008
Number of tests	2,856	2,824	2,790	2,910	2,859	2,993	3,028
Number of tests exceeding standard	0	0	0	1	3	4	2
Percentage of tests exceeding standard	0.00	0.00	0.00	0.03	0.10	0.13	0.07
Number of treatment works not meeting regulatory requirements	0	0	0	1	2	3	2
% of treatment works not meeting regulatory requirements	0.00	0.00	0.00	0.38	0.74	1.06	0.68

Turbidity is a measure of the extent to which particulate matter in the water scatters light – effectively how cloudy the water appears. Turbid waters cannot be properly disinfected, hence a treatment standard of 1 NTU has been set in the Regulations. A robust, well operated treatment process should achieve this standard with ease. In 2014 there were 13 exceedances of the standard for turbidity at 12 treatment works, marginally more than in 2013. A number of these are due to the effects of lime dosed for pH correction after disinfection, and Scottish Water needs to ensure that this effect is minimised by good mixing and careful siting of the final water sample tap. Of concern was that one treatment works, Earlish in Uig, Skye, had two failures of the turbidity standard, both of which were caused by a loss of membrane integrity. Scottish Water has carried out the necessary remedial action at this site.

Table 1.2b_ Summary of turbidity tests on samples taken at water treatment works

TURBIDITY	2014	2013	2012	2011	2010	2009	2008
Number of tests	7,374	7,298	7,331	7,745	7,855	8,123	8,250
Number of tests exceeding standard	13	12	10	24	28	26	33
Percentage of tests exceeding standard	0.18	0.16	0.14	0.31	0.36	0.32	0.4
Number of treatment works not meeting regulatory requirements	12	10	8	18	2	20	17
% of treatment works not meeting regulatory requirements	4.98	3.97	3.00	6.79	8.49	7.04	5.78

1.3_ *CRYPTOSPORIDIUM* AT TREATMENT WORKS

Cryptosporidium is a microscopic protozoan parasite that can live in the gut of humans and other animals. There are a number of species of *Cryptosporidium*, and not all are thought to be infectious to humans. All species form bodies known as oocysts which can survive in the environment for long periods. Once ingested, *Cryptosporidium* multiplies rapidly in the gut and oocysts are excreted in very large numbers, completing the life-cycle of the organism. In humans, infection can cause stomach cramps and diarrhoea and, in extreme cases, can be fatal to the immuno-compromised or to the very young or old.

Cryptosporidium oocysts can enter a water supply if faecal material is washed into the source (raw) water and oocysts are not removed by the treatment process. Standard chlorine disinfection is not generally effective against oocysts, so removal using physical filter barriers is the best option, however the small size of oocysts means that these processes must be well optimised.

The *Cryptosporidium* (Scottish Water) Directions 2003 define the measures Scottish Water is expected to take to prevent oocysts from contaminating drinking water supplies. Under the Directions, all Scottish Water's treatment works should have at least 12 final water samples taken and tested for *Cryptosporidium* during the year, with the exact sampling frequency determined by the risk assessment process. The introduction of The Public Water Supply (Scotland) Regulations 2014, which came into force on 1 January 2015, will make risk assessment a regulatory requirement and the Direction will be revoked during 2015, although Scottish Water will be expected to retain many of the operational requirements as industry best practice.

Table 1.3a_ Summary of sample data for *Cryptosporidium* in final water

CRYPTOSPORIDIUM	2014	*2013*	*2012*	*2011*	*2010*	*2009*	*2008*
Number of tests	8,851	*8,300*	*8,739*	*8,919*	*9,386*	*10,386*	*11,002*
Number of samples containing *Cryptosporidium* oocysts	124	*118*	*217*	*378*	*312*	*409*	*471*
% of samples containing *Cryptosporidium* oocysts	1.40	*1.42*	*2.48*	*4.24*	*3.32*	*3.94*	*4.28*
Number of treatment works sampled for *Cryptosporidium*	242	*252*	*267*	*264*	*270*	*281*	*292*
Number of treatment works with one or more samples containing oocysts	51	*43*	*77*	*91*	*88*	*93*	*87*
% of treatment works with one or more samples containing oocysts	21.16	*17.06*	*28.84*	*34.47*	*32.59*	*33.1*	*29.79*

Table 1.3a shows the results of tests for *Cryptosporidium* in samples taken at water treatment works in the context of previous years. Out of 8,851 samples taken from 242 treatment works in 2014, 124, or 1.40% of samples contained oocysts, a slight improvement from the previous year, and the third consecutive improvement in three years. However, the number of treatment works from which at least one positive sample was taken was 51 in 2014, higher than the 43 from 2013.

It is of great concern that at 17 membrane plants, which should present a barrier to *Cryptosporidium*, oocysts were detected at low levels in the treated water. Indeed, over a fifth, 22% of all *Cryptosporidium* detections in 2014 came from treatment works with a membrane plant. Invercannie WTW had 17 detections in 2014, this is unacceptable, and DWQR has taken enforcement action against Scottish Water to make improvements to this treatment works. Also, from other sites with membranes, Spey Badentinan had five detections, Bunessan and Earlish WTW had three and Dalmally, Kyle of Lochalsh and Mallaig WTW two each. It is vital that Scottish Water ensure membranes are regularly tested for integrity and processes are in place to enable timely replacement of membranes.

Ultrafiltration at Inverness WTW

Figures **1.3a** and **1.3b** show the breakdown of treatment types at treatment works recording *Cryptosporidium* detections. 54% of *Cryptosporidium* detections were from treatment types which should be capable of removing *Cryptosporidium* from the raw water. DWQR expects Scottish Water to ensure that these processes are working adequately and are optimised. Scottish Water must ensure all such sites are operated and maintained correctly in accordance with the reports from the groups of experts chaired by Sir John Badenoch and Prof Bouchier, and DWQR has made it clear to Scottish Water that all detections of *Cryptosporidium* should be investigated rigorously, making reference to the best practice contained within these documents.

Sites without a barrier process, or with filtration but no coagulation, accounted for the remaining 46% of *Cryptosporidium* detections. Investment is planned, or already underway at many of these sites, but Scottish Water needs to continue to assess whether *Cryptosporidium* risks are being adequately addressed and ensure action is taken via the Drinking Water Safety Planning process.

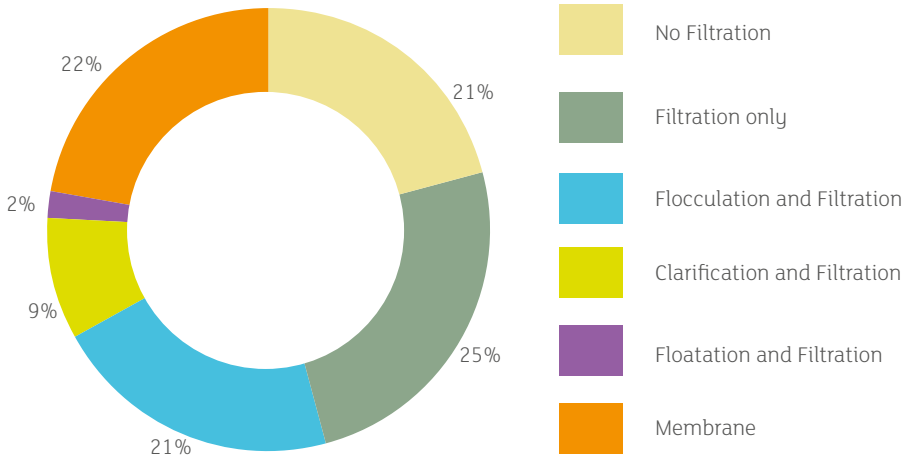


Fig. 1.3a_ Treatment types at WTW recording at least one *Cryptosporidium* detection

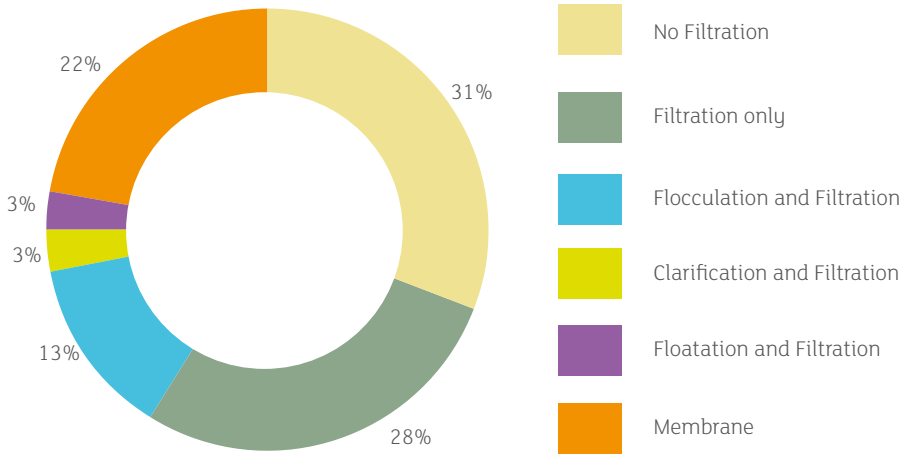


Fig 1.3b_ Treatment types at WTW recording two or more *Cryptosporidium* detections

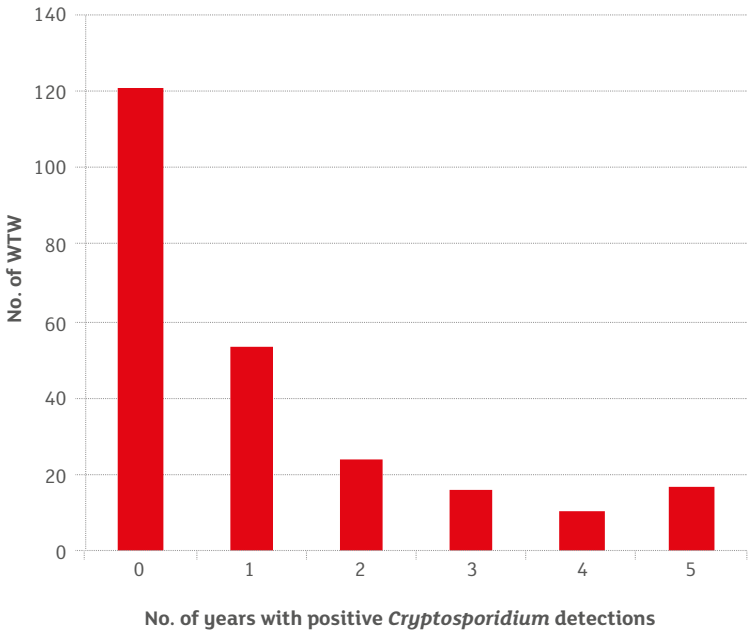


Fig 1.3c_ Number of treatment works recording *Cryptosporidium* over past five years to 2014

Figure 1.3c shows the number of treatment works which have recorded the presence of *Cryptosporidium* multiple times over the past five years. The majority of treatment works, 121, recorded no oocysts in 2014. However, it is concerning that 17 treatment works recorded oocysts in each of the five years. Indeed, it is noted that the supplies from four treatment works, Strollamus, Tullich, Torrin and Kilmuir WTW, have had *Cryptosporidium* detections in each of the past 10 years. Craignure has had oocyst detections for the past nine years; no *Cryptosporidium* samples were taken in 2005. DWQR considered enforcement action in 2013, and Tullich and Craignure have Undertakings in place to deliver improvements. Investment is planned at these five sites to ensure all supplies are free from *Cryptosporidium* – Strollamus and Torrin were removed from supply early in 2015, the remaining three schemes will be complete on or before September 2017.

Two large treatment works with full coagulation, clarification and filtration processes appear on the list of supplies with *Cryptosporidium* oocysts detected in each of the five years: Rosebery in Midlothian and Forehill in Aberdeenshire. Both of these treatment works shall be subject to audit by DWQR in 2015. Of further concern are Spey Badentinan in Moray and Bunessan on Mull, both of which have membrane treatment. The highest recorded detection of *Cryptosporidium* in 2014 from any site in Scotland was from the membrane plant at Spey Badentinan, with 0.654 oocysts per 10 litres. DWQR visited the site in 2014 to investigate, but the cause of this detection has still not been fully explained by Scottish Water as the membrane plant appears to have been functioning normally. Scottish Water appointed an external expert to audit this treatment works and they identified three possible areas for further investigation. This was implemented and actioned by Scottish Water, with only one action outstanding which relates to investigation of the raw water chamber. There have been no detection of *Cryptosporidium* oocysts since September 2014 in the 236 samples taken.

1.4_ EVENTS AND INCIDENTS AT TREATMENT WORKS

Scottish Water is required to tell the DWQR about all events that could affect water quality or cause concern to consumers. This includes all regulatory sample failures that are significant or unexpected and any failure of a treatment process. Each event is reviewed and the most serious classified as incidents. Where further information is required a full report will 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 staff, a written assessment is produced, and recommendations are made where appropriate. Incident assessments are published on the DWQR website. For the most serious incidents, enforcement action or even prosecution may be considered.

In 2014, 758 events were reported to the DWQR, of which 235 occurred at water treatment works. The majority of these events (127) were classified as not significant by DWQR, with only 33 events assessed as either serious or significant, meaning that they were declared incidents. The breakdown of classifications is shown in the pie chart in **Figure 1.4a**.

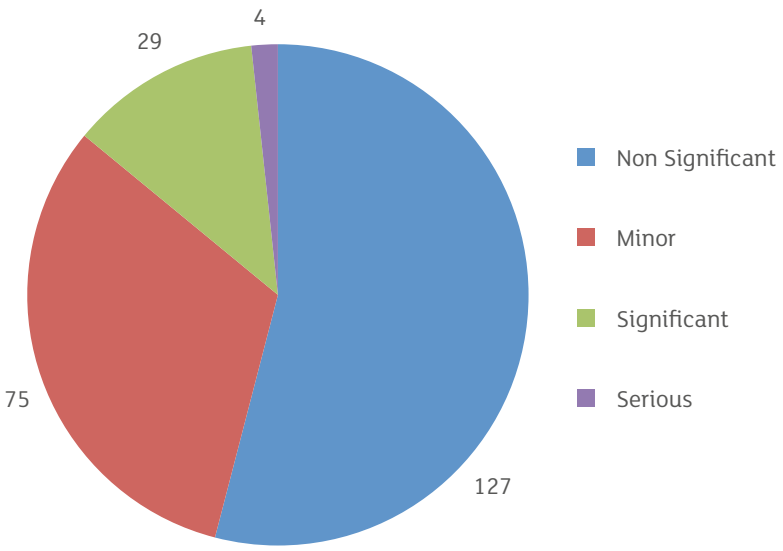


Fig 1.4a_ DWQR classification of events at Scottish Water treatment works in 2014

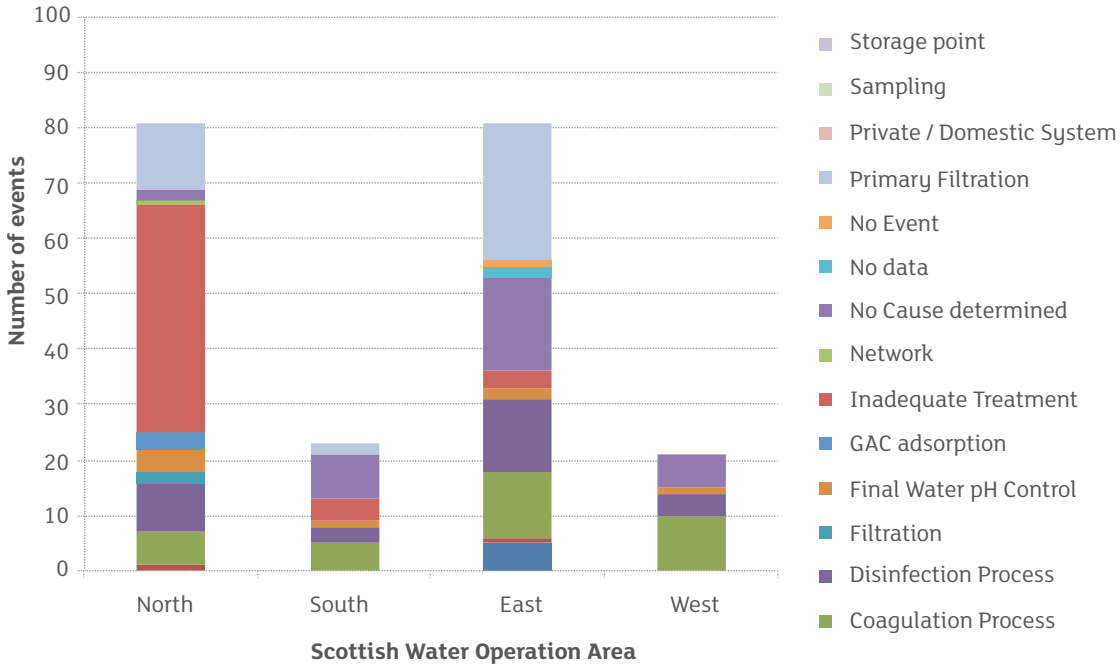


Fig 1.4b_ The nature of events at water treatment works in 2014

Invercannie WTW (Aberdeen) had a very disappointing 26 event notifications in 2014, and as discussed earlier, DWQR has served Scottish Water with an enforcement notice to make improvements to this works. Seventeen of these events at Invercannie WTW were due to detections of *Cryptosporidium* oocysts, and there were also event notifications for ammonium, pH, microbiology, aluminium and taste and odour. Mannofield WTW (Aberdeen) had 15 event notifications, which were again were mainly but not exclusively due to detections of *Cryptosporidium*. Craignure WTW (Mull), Earlish WTW (Uig, Skye) each had seven events. **Figure 1.4b** shows the nature of events at water treatment works during the year.

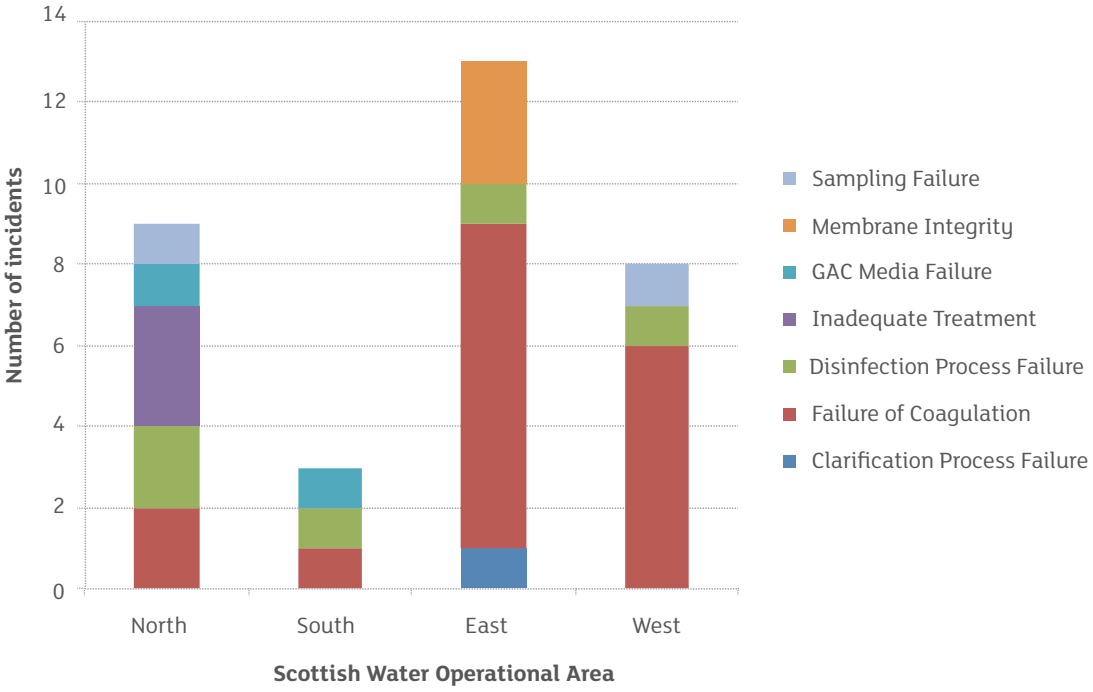


Fig 1.4c_ The nature of incidents at water treatment works in 2014

Annex A lists incidents declared in 2014. Thirty-three occurred at treatment works, a significant increase on the 14 incidents at treatment works in 2013. This accounts for 63% of all incidents, coincidentally the same percentage as in 2013. This is indicative of the potential for events occurring at treatment works to affect a large population and have serious implications for water quality. **Figure 1.4c** shows the nature of incidents occurring at treatment works. It is disappointing to note that there were 17 incidents involving coagulation failure at water treatment works in 2014, compared with one in 2013. This is quite simply unacceptable, as failure of the coagulation process can lead to a wide range of significant water quality issues, and DWQR expects Scottish Water to control coagulation processes more closely. There were five failures of disinfection processes which were declared as incidents: failure to disinfect can lead to microbiological contamination of supplies and can present a risk to health. The Public Water Supplies (Scotland) Regulations 2014, which came into force on the 1st January 2015, make it an offence for Scottish Water to supply water for human consumption that is not sufficiently treated or disinfected, and DWQR will be carefully monitoring Scottish Water's compliance with this duty.

A full list of incidents that occurred at water treatment works during 2014 is provided in **Annex A**. Several key incidents at treatment works are described in more detail overleaf:

Lochenkit WTW, Dumfries and Galloway – Disinfection Failure – June 2014
Following a power cut, delays in the changeover of power from a temporary generator back to mains power led to an airlock in the chlorine disinfection system. There were issues with the manufacturer's calibration procedure for the chlorine monitoring system, but also problems with flow to the chlorine monitors. Undisinfected water was supplied to the public for over nine hours. DWQR was highly critical of the lack of sampling in response to this incident, as no appropriate samples were taken to determine the quality of the water supplied to consumers. DWQR recommended that Scottish Water carry out a review of sampling protocols following disinfection failures with Health Board and Environmental Health stakeholders, along with a review of operational procedures and staff training associated with the incident. DWQR was also concerned about the lack of robustness surrounding the chlorine dosing and monitoring at the site, and recommended that Scottish Water review both. Scottish Water intends to close Lochenkit WTW once improvements to a neighbouring water treatment, Killylour WTW are complete. DWQR is keen that that there is no delay to this change of supply and is monitoring the progress of the improvement scheme carefully. DWQR visited both Lochenkit and Killylour WTW in February 2015.

Neilston WTW – Taste and Odour Complaints – August 2014
Scottish Water responded to a number of calls complaining of taste and odour in their drinking water supply. Following investigation by Scottish Water, it was determined that the presence of algae in the raw water supply had caused high turbidity water to leave the dissolved air floatation system, and this turbid water had overwhelmed the rapid gravity filters. The turbidity standard was exceeded in the final water at the water treatment works, and samples from consumers' taps showed failures of the aluminium standard. DWQR was highly critical of the lack of sampling in response to this incident: despite high turbidity suggesting a high risk from *Cryptosporidium*, no samples were taken for *Cryptosporidium*. Additionally, despite algae having been observed in the raw water, no sampling was carried out to determine the load of algae onto the works, the efficacy of removal of the algae, or the type of algae present. Scottish Water had been due to main out Neilston WTW later in 2014, but was able to bring forward the connection to the new main to supply the area from an alternative treatment works. DWQR recommended that Scottish Water should carry out training to increase awareness of the risk from algal blooms and develop and implement a suitable operational management procedure for response to algae in raw water.

Savalbeg WTW, Lairg – Elevated Aluminium – April 2014
Scottish Water set up a trial for an alternative flocculant in an attempt to improve the performance and potentially increase the throughput of the treatment works. Despite no plant operators being on site, as they had been called out on standby duty the previous night, process scientists proceeded with the trial. During the changeover of the flocculant, aluminium levels rose rapidly and the trial was abandoned. Attempts to run the works to waste failed, and the concentration of aluminium in the final water exceeded regulatory standards. The trial commenced again the next day, this time with the site operators present, but without any tests or investigations into the cause of the problems from the previous day. Again, the incorrect dose of chemical was used and aluminium levels exceeded regulatory standards, resulting in blocked filter media.

DWQR was highly critical of the trial taking place without the presence of trained plant operators on the site on the first day, and the second trial having been attempted without understanding the cause of the earlier problems was unacceptable. No samples were taken in distribution to assess the risk to consumers, and final water quality was not monitored during the trial. DWQR considers that this incident was avoidable, and has recommended that Scottish Water reviews its systems in place to control and authorise the access to treatment processes, and implements a formal 'licence to operate system' for treatment operators.

SECTION 2 STORAGE

The public water supply is carried to consumers through a network of water mains and storage tanks and this is known as the distribution system. Depending on the size and location of communities served and the size of the treatment works, these can be very large systems covering an extensive geographical area or can consist of one or two short lengths of small diameter pipes. The condition of storage tanks can have a significant effect on the quality of water passing through them. If the integrity of the distribution system is breached, or re-growth of microbiological organisms occurs, bacterial contamination can be a problem. In practice, such problems are rare, but careful management of the distribution system is required in order to ensure that the quality of the treated drinking water is not allowed to deteriorate on its way to consumers.

2.1_ STORAGE TANKS

Service reservoirs and water towers are located at points in the distribution system to store water, both for hydraulic reasons and to even out the demand for water through the day. If these storage tanks are not maintained they can be prone to inward leakage from contaminated surface water. This needs to be controlled through inspection and maintenance. Scottish Water adopts a risk-based approach to cleaning and refurbishing storage tanks.

Secondary disinfection is installed at some storage tanks, but this should in DWQR's opinion only be used where chlorine residuals diminish because of long distribution networks. In such cases there may be a need to boost disinfection levels to achieve a disinfection residual at the end of the network. It is important that secondary disinfection does not disguise a more fundamental problem with a storage tank or within the water mains such as poor structural condition.

DWQR inspects a selection of structures each year in order to ensure that they are being maintained and operated in a manner that minimises risk to water quality.

Coliforms and *E. coli* are two parameters measured in samples regularly taken from storage tanks to verify that water quality has been maintained within the distribution system and to identify any instances where the water may have become contaminated. Coliforms, of which *E. coli* (faecal coliforms) is one species, are a group of bacteria, that are commonly found in the environment. The presence of *E. coli* indicates that contamination by faecal material has occurred. While some detections of coliforms are potentially due to issues associated with sampling, such as the condition of the sample point, all coliform failures must be fully investigated by Scottish Water and reported to DWQR, the local NHS board and local authority.

Summary results for storage tanks in 2014 (**Table 2.1a**) show that there was a higher incidence of bacteriological sample failures than reported in 2013. The Regulations require that no sample from storage points should contain *E. coli* and at least 95% of samples may not contain coliforms. One hundred and four samples contained coliforms (one storage tank failed to meet the 95% requirement) and two samples contained *E. coli.* The performance against the *E. coli* standard shows an improving trend over the past few years. The coliform failures were recorded across 96 sites which is a poorer position than 2013 where 69 sites were affected. Whilst more coliform failures were reported in 2014 compared with the previous year, the overall trend since 2007 is fairly static.

Table 2.1a_ Summary of microbiological tests on storage tanks

COLIFORM BACTERIA	2014	*2013*	*2012*	*2011*	*2010*	*2009*	*2008*	*2007*
Number of tests	51,533	*51,523*	*52,226*	*51,952*	*49,877*	*53,001*	*55,104*	*56,277*
Number containing coliforms	104	*73*	*109*	*122*	*106*	*137*	*137*	*127*
% containing coliforms	0.20	*0.14*	*0.21*	*0.23*	*0.21*	*0.26*	*0.25*	*0.23*
E. coli								
Number of tests	51,533	*51,591*	*52,226*	*51,952*	*49,877*	*53,001*	*55,102*	*56,277*
No. containing faecal coliforms	2	*5*	*7*	*13*	*9*	*12*	*11*	*16*
% containing faecal coliforms	<0.01	*0.01*	*0.01*	*0.03*	*0.02*	*0.02*	*0.02*	*0.03*

Scotland has a large number of storage tanks and Scottish Water has a duty to maintain its assets so that they do not introduce a risk to water quality. In 2013, Scottish Water adopted a new process for the investigation of failures of microbiological standards, seeking to determine and understand the root causes of each event. This has been a valuable tool to Scottish Water in gaining an understanding of issues at failing sites and the drop in failures noted in 2013 was attributed to this new approach, so it is disappointing to note that the number of failures in 2014 has risen despite this new investigation process.

All storage tanks except one met the regulatory requirement that 95% of samples should not contain coliforms. This failure was at Kippen near Stirling, where two samples out of 34 contained coliforms. This asset was identified as being in poor condition with several potential points of ingress. Consequently it was taken out of use in August 2014 and is awaiting repair. **Table 2.1b** shows the poorest performing sites in 2014.

Table 2.1b_ Storage tanks with reduced mircobiological performance

STORAGE TANK	LOCATION	% SAMPLES WITH NO COLIFORMS	NO. OF SAMPLES TAKEN
Kippen	Kippen, Stirling	94.12	34
Maypark	by Aberlour, Moray	96.00	50
Broomhills	By Bonchester Bridge, Scottish Borders	96.15	52
Kingswells	Aberdeen	96.15	52
Ellon Low Level	Ellon	96.15	52
Sandwick	Orkney	96.15	52
Baggerton	by Forfar, Angus	96.67	30

The monitoring requirement for storage tanks is to take weekly samples when they are in service and a 'live' part of the water supply route. A number of sites fell short of recording 52 samples in the year and DWQR is satisfied that this is substantially due to the storage point being withdrawn from supply for a period of time for inspection, cleaning or repair. It is concerning that 10 storage tanks failed in both 2014 and 2013 (given in **Table 2.1c**) and a further 14 storage tanks failed in both 2014 and 2012. Scottish Water must continue to improve their understanding of these failures and resolve the issues at these sites.

Table 2.1c_ Storage tanks with reduced mircobiological performance in both 2013 and 2014

STORAGE TANK	LOCATION	% SAMPLES WITH NO COLIFORMS	NO. OF SAMPLES TAKEN
Ellon Low Level	Ellon	96.15	96.22
Doonhill	Newton Stewart	98.00	98.08
Greenhead	Ardrossan	98.15	98.08
Longplantings	Haddington	98.04	97.96
Bruichladdich	Islay	98.04	98.11
Banchory Arbeadie	Banchory	98.04	98.11
Stonebyres	Lanark	98.08	96.15
Largie	Insh, Aberdeenshire	98.08	98.11
Rattray	Blairgowrie	98.08	98.08
Culburnie	Beauly	98.11	95.83

Storage Tank at Gairloch

2.2_ EVENTS AND INCIDENTS IN STORAGE

In 2014, 758 events were reported to the DWQR, of which 119 were raised in relation to sample failures or issues in storage points. Four of these events were declared incidents which translates to fewer than 8% of all incidents as occurring in storage.

The majority (87%) of storage point events related to microbiological failures where the integrity of the tank structure or access cover seals may have allowed the ingress of surface water into the stored water area.

Scottish Water has established a larger resource of staff to investigate water quality issues and it is clear that this has resulted in a more focussed examination of the root causes of microbiological failures. In some cases however, it has not been possible to attribute a definite root cause to the event. In 2014, seven event investigations concerning microbiological failures at storage points were unable to identify the cause of the failures. This has improved significantly from 2013 where 27 events at storage points were reported as from an undetermined cause.

DWQR declared four incidents from event notifications occurring from storage points. One was categorised as major by DWQR, two as serious and one as significant.

A description of all incidents is provided in **Annex A** and summaries of all incident investigations are published on the DWQR website www.dwqr.org.uk.

The following incident is of particular note, requiring significant investigation by DWQR:

Rosemarkie, nr Fortrose
A third party JCB driver caused a burst on the outlet main from Rosemarkie service reservoir, the damage occurred in a cattle field. Scottish Water Operations were alerted and shut down the main which was promptly repaired and recharged. Six days after the repair a sample was taken from the sample tap at Rosemarkie service reservoir (downstream of the repair) which contained coliforms. Several other samples taken at this time also contained coliforms. A 'boil water' notice was issued by Scottish Water to approximately 550 residents downstream of the failing sample. This was lifted two days later following several sets of satisfactory samples.

DWQR is of the opinion that it is not possible to exclude the possibility that the contamination entered the outlet main from Rosemarkie service reservoir during the repair to the burst main. DWQR consider that it was unacceptable that no post-repair samples were taken by Scottish Water which could have detected any contamination immediately after the work was completed, rather than six days later as was the case. This is clearly in contravention of water industry guidance and Scottish Water procedures. The subsequent investigative samples were not taken to industry standards and were unlikely to be representative of the water quality. DWQR is disappointed that Scottish Water's failure to follow their own mains repair procedures, compounded by poor sampling, led to this incident which left consumers unable to drink their supply without first boiling it. The incident was categorised as serious.

SECTION 3 NETWORK AND CONSUMERS

The public water supply is carried to consumers through a network of water mains. These can be very large systems covering an extensive geographical area or can consist of one or two short lengths of small diameter pipes. The pipeline materials and the condition of the pipes can have a significant effect on the quality of water passing through them. Cast iron mains can corrode and add particles of iron to the water and deposits of iron, manganese or aluminium can accumulate in the system, perhaps from inefficient treatment processes, long since replaced. These deposits can be disturbed by changes in the flow causing discoloured supplies. Careful management of the network is required in order to ensure that the quality of the treated drinking water is not allowed to deteriorate on its way to consumers.

3.1_ WATER QUALITY AT CONSUMERS' TAPS

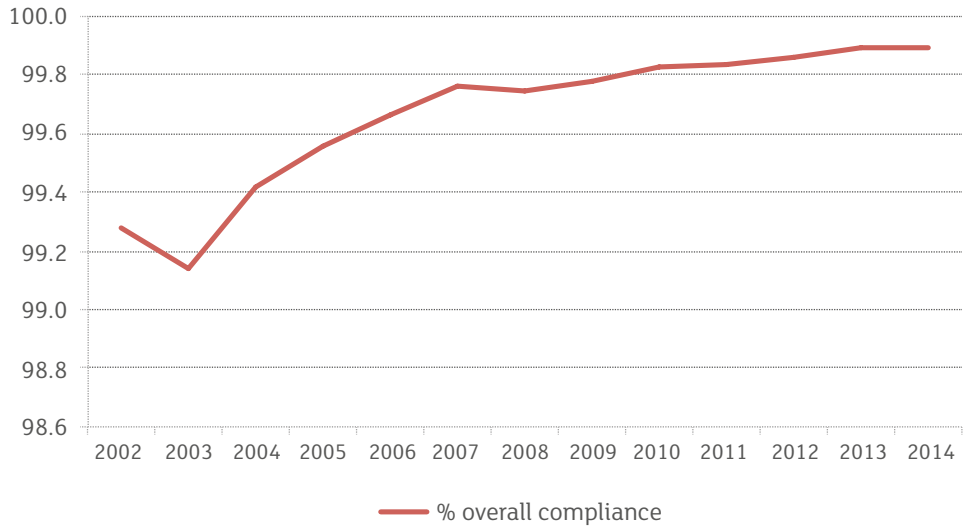
Scottish Water's supply area is divided into 290 water supply zones. Most sampling to assess regulatory compliance takes place at consumers' taps, and testing takes place for 51 parameters. Sampling frequencies are determined by the size of the population in the water supply zone.

99.89% of tests complied with the standards

In 2014, 151,714 tests were carried out on samples taken at consumers' taps. Of these, 160 failed to meet the standard set out in the Regulations. This means that 99.89% of tests carried out at consumers' taps complied with the standards. The equivalent figures for 2013 were 162 failing samples and 99.89% compliance, demonstrating a sustained level of performance.

Overall Compliance

Figure 3.1a shows the overall compliance figure at consumers' taps every year since Scottish Water was created in 2002. The sustained level of performance is clearly seen.



Ninety-four supply zones had a sample taken in 2014, that failed to meet one or more of the standards, which is poorer than 2013's figure of 88 but nonetheless, still better than the 117 recorded the previous year. The majority of the increase was due to failing microbiological parameters.

Scottish Water's overall figure for Mean Zonal Compliance (MZC) with the parameters in Schedule 1 of the Regulations was 99.91% (the methodology for calculating this measure is shown in Appendix H). This allows comparison with performance in England and Wales, where the MZC measure is used as the indicator of overall drinking water quality.

Table 3.1a shows the test results of samples taken from randomly selected consumers' taps. Compliance for a number of key parameters is then discussed in more detail.

Table 3.1a_ Summary of all tests on consumer tap samples during 2014

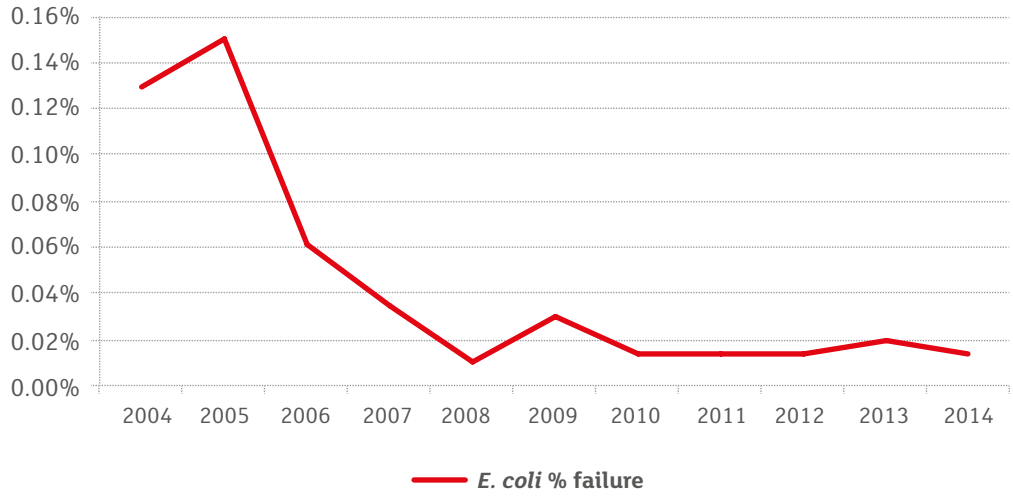
PARAMETER	TOTAL NO. OF SAMPLES	NO. FAILED SAMPLES	NO. ZONES WITH FAILURES	% COMPLIANCE
KEY PARAMETERS				
Coliform Bacteria	14,055	63	50	99.55
E. coli	14,055	2	2	99.99
Colour	5,102	0	0	100.00
Turbidity	5,102	1	1	99.98
Hydrogen ion (pH)	5,101	1	1	99.98
Aluminium	5,068	1	1	99.98
Iron	5,068	19	16	99.63
Manganese	5,068	15	14	99.70
Lead (10)	1,500	12	10	99.20
Total Trihalomethanes	1,521	16	10	98.95
1,2 Dichloroethane	1,514	0	0	100.00
Aldrin	1,512	0	0	100.00
All Other Individual Pesticides	12,862	5	2	99.97
Ammonium	5,103	1	1	99.98
Antimony	1,500	0	0	100.00
Arsenic	1,500	0	0	100.00
Benzene	1,523	0	0	100.00
Benzo 3,4 Pyrene	1,474	1	1	99.93
Boron	1,500	0	0	100.00
Bromate	1,470	0	0	100.00
Cadmium	1,500	0	0	100.00
Chloride	1,499	0	0	100.00
Chromium	1,500	0	0	100.00
Clostridium perfringens	5,069	5	5	99.90
Conductivity	5,102	0	0	100.00
Copper	1,499	0	0	100.00
Cyanide	1,499	0	0	100.00
Dieldrin	1,512	0	0	100.00
Enterococci	1,501	1	1	99.93
Fluoride	1,499	0	0	100.00
Heptachlor	1,512	0	0	100.00
Heptachlor epoxide	1,501	0	0	100.00
Mercury	1,500	0	0	100.00
Nickel	1,500	0	0	100.00
Nitrate	2,472	0	0	100.00
Nitrite	2,419	8	6	99.67
Nitrite/Nitrate formula	2,427	0	0	100.00
Odour	5,104	1	1	99.98
PAH - Sum of 4 Substances	1,474	1	1	99.93
Pesticides - Total Substances	4,484	1	1	99.98
Selenium	1,499	0	0	100.00

PARAMETER	TOTAL NO. OF SAMPLES	NO. FAILED SAMPLES	NO. ZONES WITH FAILURES	% COMPLIANCE
Sodium	1,500	0	0	100.00
Sulphate	1,499	0	0	100.00
Taste	5,105	5	5	99.90
Tetrachloroethene/Trichloroethene	1,508	0	0	100.00
Tetrachloromethane	1,521	0	0	100.00
Tritium	956	0	0	100.00
SCOTLAND	**151,714**	**160**	**95**	**99.89**

Key Water Quality Parameters

Compliance against the standards set for the key water quality parameters is presented in the following charts.

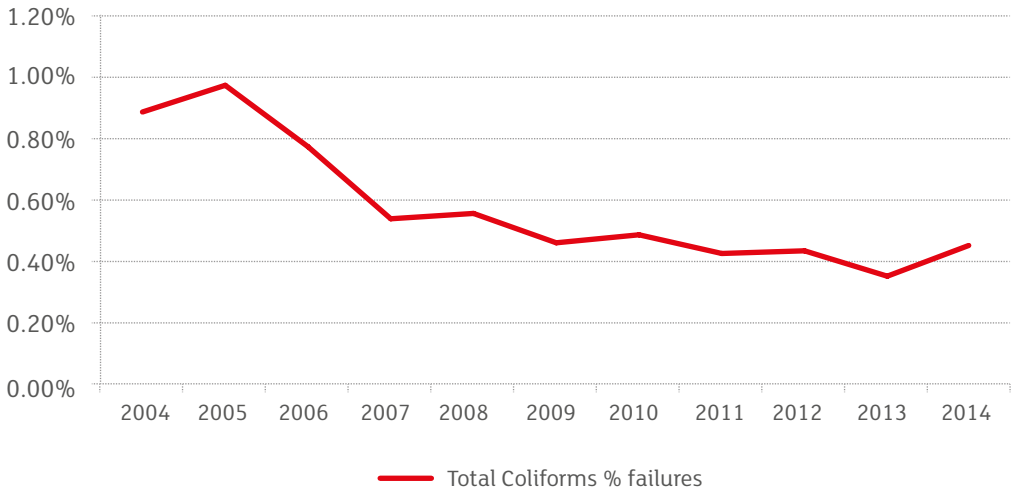
E. coli



E. coli is an extremely important parameter because it is an indicator of faecal contamination and the microbiological safety of the water. Compliance for this parameter is relatively stable with only a very low number of failures occurring each year. Two samples failed last year. These failures represent only 0.01% of tests undertaken for this parameter.

The detection of *E. coli* in a water sample may be an indication that the supply in that area has become contaminated or it may simply relate to the tap from which the sample was taken. Scottish Water must investigate each failure thoroughly to try to determine the cause and respond appropriately.

Total Coliforms

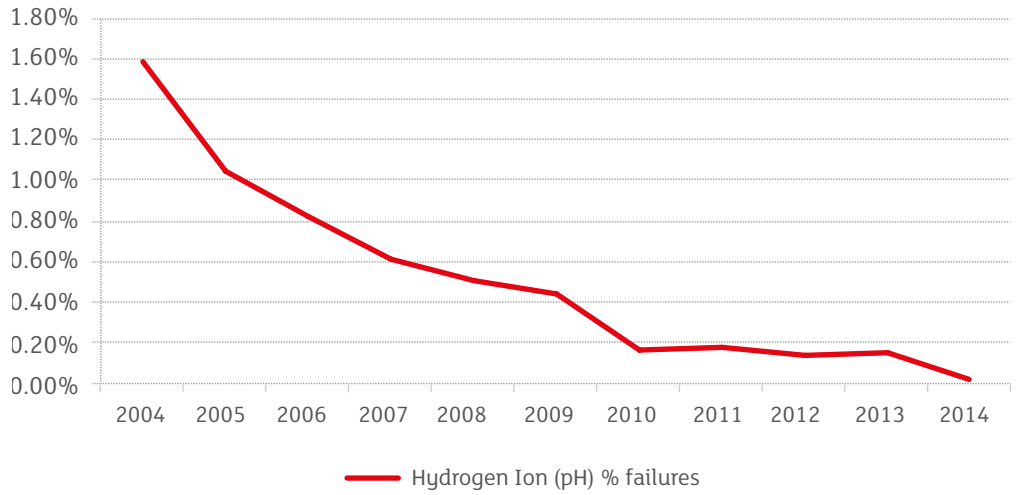


Total coliforms represent the group of bacteria of which *E. coli* is one species. They are common in the environment and do not necessarily indicate faecal contamination, but should not be present in the water supply as they are readily deactivated by chlorine, which is added in controlled amounts to all of Scottish Water's supplies.

Coliforms were detected in 63 samples in 2014, an increase of 13 from the previous year and the poorest compliance since 2010. This deterioration mirrors similar trends at WTW and storage points and is especially disappointing as Scottish Water has worked to better understand causes of failures, and improve assets.

There does not appear to be a geographical pattern to the exceedences, with the majority (37) of the failures occurring singly in a supply zone. Having said this, Clatto East supply zone in Dundee had three failures, which warrants further investigation by Scottish Water. It is undoubtedly possible to bring about an improvement in microbiological compliance, by such means as thorough treatment of water, diligent maintenance of storage points and distribution systems to ensure their integrity and cleanliness and careful management of residual chlorine and water age. Scottish Water has demonstrated that improvements are possible, and the improved microbiological quality of the Mannofield zones around Aberdeen demonstrates this.

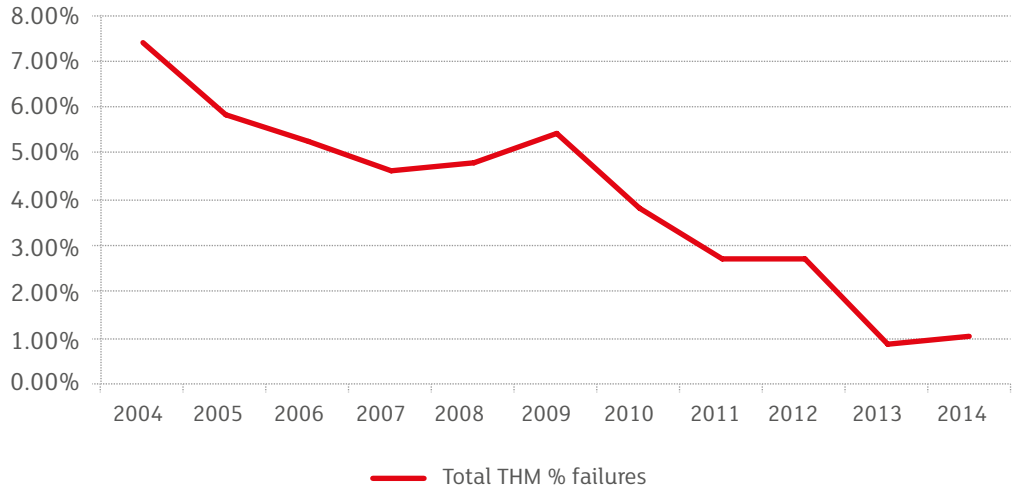
Hydrogen Ion (pH)



The pH of a substance is the measure of how many hydrogen ions it contains, with large numbers of hydrogen ions making it more acidic. 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 sometimes occur where water is in prolonged contact with some water mains containing cement. Waters with a very high pH can have a taste that some consumers find unpleasant.

Compliance for pH has improved on previous years and is the best ever, with one failure in 2014 compared with eight the previous year.

Total Trihalomethanes (THM)



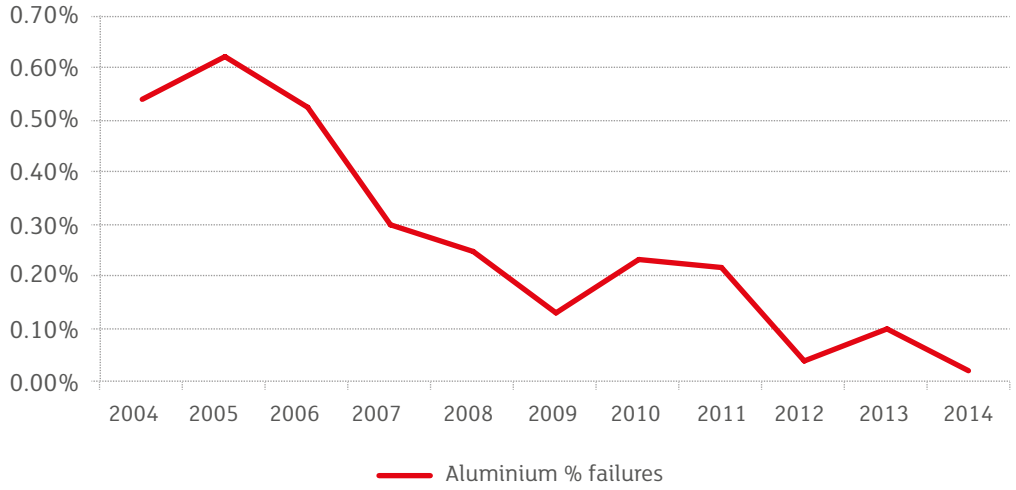
THMs are one group of disinfection by-products that can form when organic substances combine with chlorine used to disinfect the water. As Scotland's upland waters are naturally rich in these precursor compounds, management of THM formation presents Scottish Water with a challenge, nevertheless one that must be met. Scottish Water has devoted much effort to reducing the formation of THMs in its water supplies and has managed to maintain the substantial improvements seen in 2013.

During 2014, Scottish Water has worked hard to understand the characteristics of its raw waters and their potential to form THMs when chlorinated. A range of techniques have been employed to improve organics removal at treatment works and reduce THM formation in distribution systems. This work is demonstrating a clear benefit and is welcomed.

Tullich water supply zone in the Oban area recorded four THM failures during the year due to the inability of the treatment process at Tullich to remove organic precursor compounds. A new treatment process is being designed and constructed and Scottish Water has given Scottish Ministers a legally binding commitment on delivery, with improvements to be delivered by September 2017.

Bunessan supply zone on Mull had two THM failures in 2014, both resulting from inadequate removal of precursors by the membrane process. This has also been an issue at other sites and is being addressed by Scottish Water.

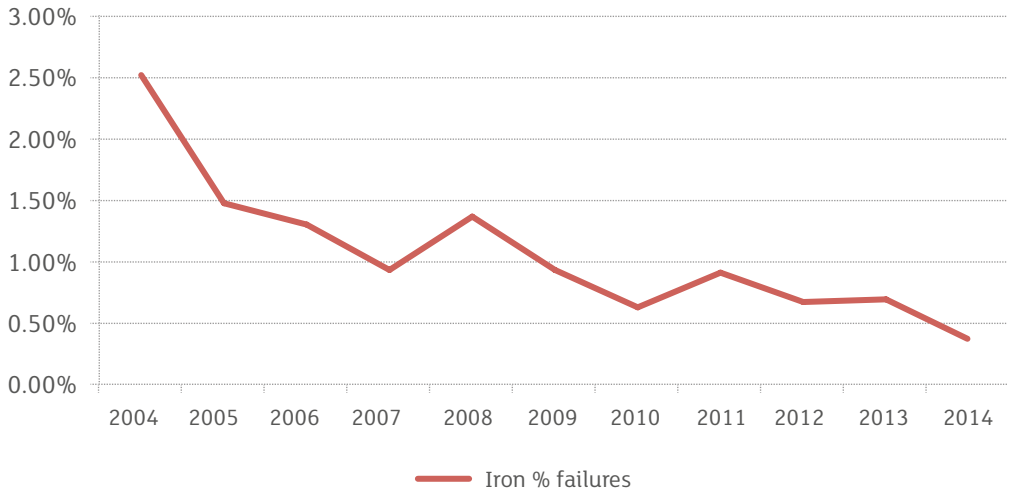
Aluminium



Aluminium can be naturally occurring in water. It is also used as a flocculant in some water treatment processes and, if these are not operating efficiently, it can enter the water supply via this route. Generally it is not of significant health concern, but high concentrations can lead to taste complaints and affect dialysis patients.

The number of exceedences of the aluminium standard has reduced significantly since Scottish Water was created in 2002. Only a single failure of the standard occurred in 2014, which is the best compliance ever recorded in Scotland and reflects work undertaken by Scottish Water to improve control of its treatment processes.

Iron

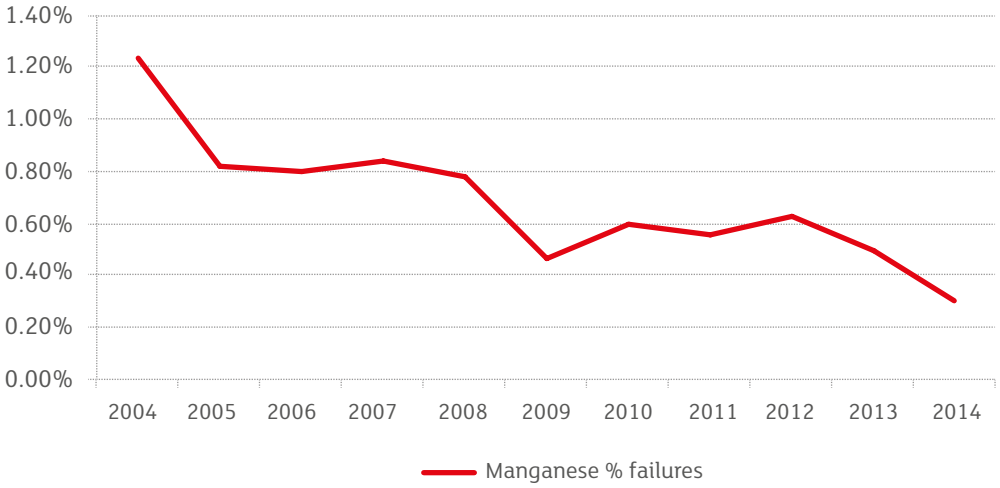


Iron occurs naturally in some water supplies but should be removed by the treatment process. It is used as an alternative flocculant to aluminium at a few treatment works in Scotland. The most common cause of failures of the iron standard at consumer taps is corroding cast iron water mains which can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

Compliance with the iron standard has improved significantly in 2014, which is encouraging. Scottish Water has embarked on a large programme of renovation of the water mains that cause the most significant water quality issues and has developed techniques and measures to ensure that quality is managed on an on-going basis in the meantime. This should also have the effect of reducing the number of discolouration complaints received by Scottish Water from consumers.

Greenock supply zone in the West was the only supply zone that recorded three failures of the standard for iron. A significant amount of rehabilitation work has already been undertaken in this zone over the years, but further work in the area is likely to be required. Marchbank A supply zone, covering Livingston and the area west of Edinburgh was the only other supply zone with more than one iron failure during the year.

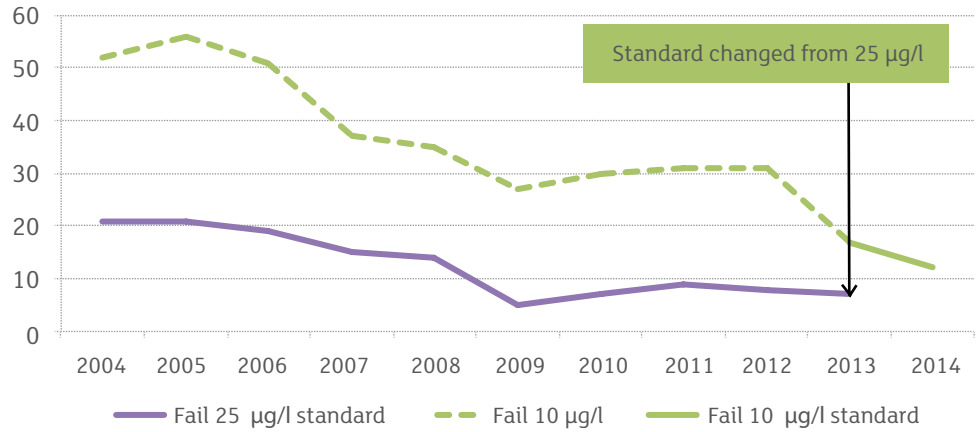
Manganese



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 a fine black sediment in distribution system pipework and cause severely discoloured water supplies and great inconvenience for consumers. Overall compliance improved in 2014. Even a relatively low concentration of manganese in the final water of a treatment works can accumulate in pipes and cause problems in distribution pipework.

The only water supply zone that recorded more than one failure in 2014 was Turret A, which covers Stirling and the Trossachs. This is not an area commonly associated with manganese, and needs close monitoring and action by Scottish Water to prevent further deterioration. Muirdykes water supply zone near Paisley has a water quality undertaking to resolve manganese issues by March 2017.

Lead



Lead does not occur naturally in water supplies in significant quantities, but may fail the standard at consumers' taps where lead piping is present in a property. 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.

The standard for lead reduced from 25µg/l to 10µg/l at the end of 2013. Although the annual number of failures has increased slightly as a result in 2014, the magnitude of the increase is not large. If the compliance trend against 10µg/l is considered (dotted line), the 2014 data shows a significant decrease in non-compliance when compared to 2013.

All failures occurred singly in water supply zones, with the exception of the Burncrooks & Blairlinnans supply zone, where three out of four samples failed. DWQR has initiated enforcement action against Scottish Water in respect of lead compliance in this zone in order to ensure that planned orthophosphate dosing is installed without delay and by the end of 2015.

Other Notable Parameters

Taste

Failures of the standard for taste occurred at five locations in 2014. As these were all on different water supplies it is highly likely that they are attributable to localised causes.

Clostridium perfringens

Clostridium perfringens is a spore forming bacterium that can persist for long periods in water distribution systems and may indicate historic contamination by faecal matter. Although unlikely to cause illness in the low quantities found in the water supply, *Clostridium* can multiply to dangerous levels in foodstuffs and detections should be taken seriously.

In 2014, five samples contained *Clostridium*, the highest number of failures for several years. This is of some concern given the adverse trend in other microbiological indicators. *Clostridium* detections are often attributed to unknown causes, and it may be that greater efforts are required in order to identify reasons for failures. The failures were in five different supply zones.

The primary role of *Clostridium perfringens* is as an indicator of remote or historic faecal contamination which has its greatest use as an indicator of the adequacy of the operation of water treatment. DWQR is of the opinion that Scottish Water should consider the validity of routinely including this parameter in water supply zone compliance monitoring.

Nitrite

Nitrite forms when nitrifying bacteria act on ammonia that is added to chlorine in a process known as chloramination. If the process is not tightly controlled and nitrifying bacteria are allowed to persist in the distribution system due to high water residence times, failures of these parameters can result.

In 2014 there were eight failures of this parameter which reflects a decrease on 2013, but not a return to 2012 levels. Two supply zones had multiple failures of the nitrite standard. One of these was Spynie zone which supplies the area around Elgin in Moray, where issues were also recorded in 2013. The other was Pateshill supply zone in West Lothian, which recorded two failures later in the year and appears to be an emerging problem that Scottish Water must address.

Individual Pesticides

Five exceedances for individual pesticides occurred during 2014, compared with none in 2013. These were all in two related supply zones in Fife – Lomond Hills and Lomond Hills Borehole Mix and concerned the pesticides MCPA and 2,4-D. The 0.1 micrograms per litre standard for individual pesticides is not health based standard and the failures carry no significance for health, however Scottish Water is expected to ensure that measures are taken to prevent a recurrence.

The exceedances have been attributed to farming activities in the catchment for Lomond Hills WTW and work is underway with catchment stakeholders to prevent pesticides reaching watercourses and, ultimately, the treatment works.

3.2_ PUBLIC BUILDINGS

The European Drinking Water Directive requires that Member States have regulations to deal with the monitoring of water quality in buildings to which the public have access. In order to fully transpose this requirement into Scottish law, The Water Quality (Scotland) Regulations 2010 ("the 2010 Regulations") were laid.

In 2014, 7618 tests were undertaken on samples collected from public buildings by Scottish Water. Of these, 12 failed to meet the regulatory standard, with five samples containing low levels of coliforms and three exceeding the standard for trihalomethanes. One sample contained 29 coliforms and 13 *E. coli*, however this was attributed to tap hygiene.

DWQR assessed all of these failures as being not significant, with appropriate remedial measures in place.

3.3_ WATER MAINS NETWORK

The Distribution Maintenance Index, or DMI, is a measure used to monitor the performance of distribution systems. DMI looks at regulatory sample data for turbidity, iron and manganese at consumer taps since these three parameters best reflect the performance of the water mains network and its tendency to cause discoloured water incidents.

The mean DMI for all zones was 99.89%, which is the highest level achieved by Scottish Water.

Turbidity is a measure of the cloudiness of the water. Iron and manganese are the two substances most commonly associated with discoloured supplies. Whilst iron in water supplies is commonly associated with the corrosion of cast iron water mains, it may also originate from a water treatment works which is failing to adequately remove naturally occurring iron from the raw water, or adding it as a coagulant. Manganese is a naturally occurring substance found in raw waters in some parts of Scotland. If treatment processes are insufficient to remove it, it passes into the distribution system. Both iron and manganese may be deposited in pipes where low flows enable them to settle out and accumulate. Such deposits may later be disturbed by changing flow patterns causing discoloured supplies. DMI is a measure of the extent to which these substances are accumulating in the distribution system and the effectiveness of the techniques used by Scottish Water to keep the distribution system clean. A full description of DMI, which is derived from the Mean Zonal Compliance for the three parameters, can be found in **Annex H**.

Fig 3.3a shows the DMI trend since its introduction as a measure in 2005, together with the mean zonal compliance of the three index parameters.

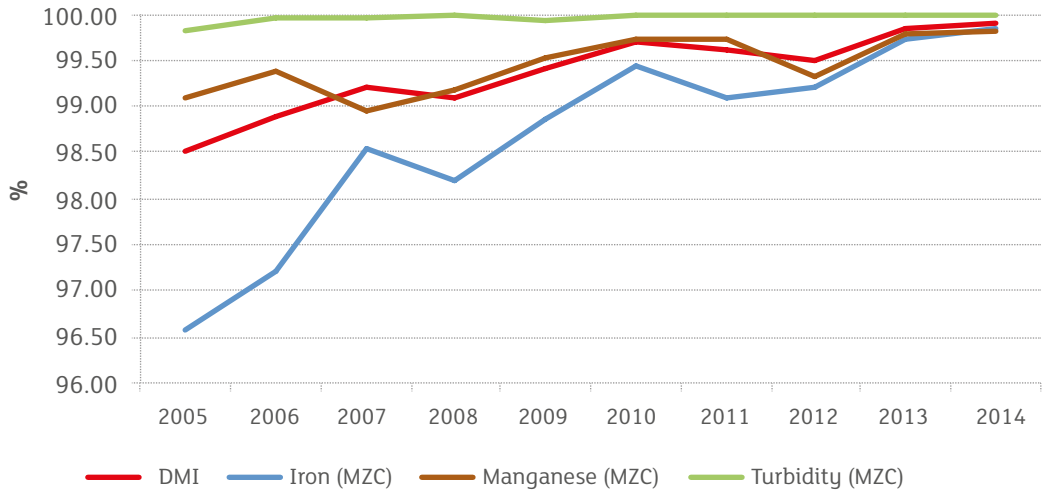


Fig. 3.3a_ Distribution Maintenance Index

The mean DMI for all zones was 99.89%, which is the highest level to be achieved by Scottish Water since the use of this measure was introduced in 2005. 28 supply zones recorded a failure of an index parameter which is also the lowest number of zones since 2005. Iron and manganese are the main contributors to performance and **Figure 3.3b** shows the regional breakdown of the number of zones with iron and manganese failures.

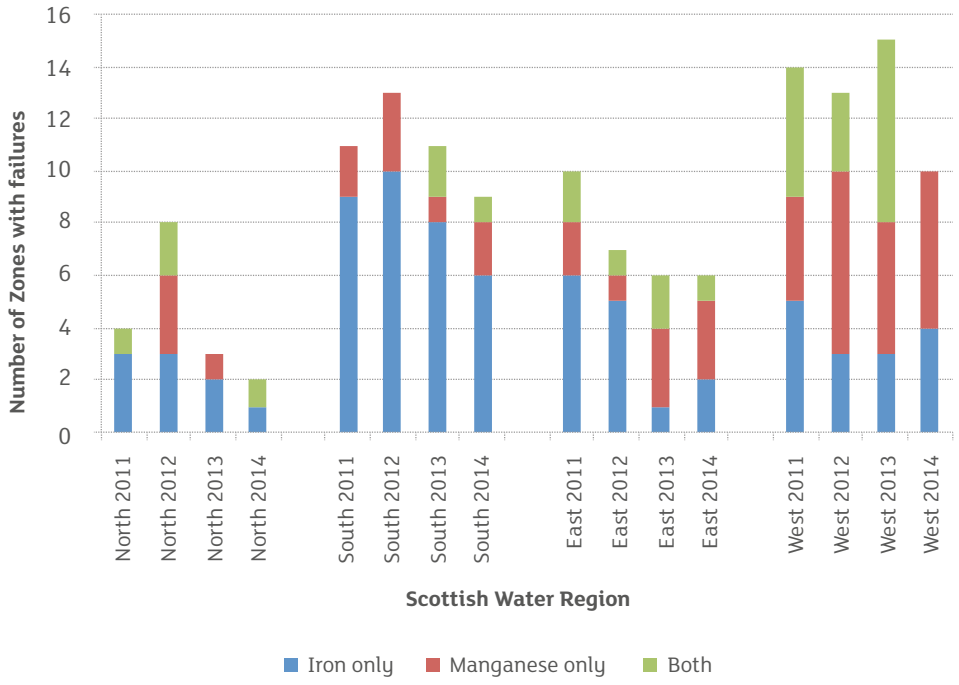


Fig. 3.3b_ Distribution Maintenance Index

The impact of excessive levels of iron and manganese in the water main network is that consumers receive discoloured water. Failures of these parameters may be related to the condition of the water supply network but they may also be caused or exacerbated by operational activity, such as the operation of valves or burst mains, causing flow changes within the water mains.

Three regions show an improved position in 2014. The much improved manganese position in the West region of Scotland, where the number of zones failing this parameter has reduced from twelve to six, is welcomed. The only region not to have shown an improved position is the East, which, after a regularly improving trend, remains static with six failing zones.

3.4_ SCOTTISH WATER CONSUMER CONTACTS

When a consumer calls Scottish Water regarding the quality of their water supply, the contact is recorded and classified according to the categories listed in **Annex G.** **Table 3.4a** shows the number of contacts, by type, that Scottish Water received during 2014.

Table 3.4a_ Consumer contacts received by Scottish Water

CONTACT CATEGORY	NUMBER OF CONTACTS				% CHANGE ON 2014	CONTACT RATE PER 10,000 POPULATION			
	2014	2013	2012	2011		2014	2013	2012	2011
APPEARANCE									
Discoloured Water	9,278	*7,172*	*8,279*	*17,940*	*29.4*	*18.3*	*14.4*	*16.6*	*35.9*
Aerated (Milky) Water	1,558	*1,587*	*2,536*	*2,897*	*-1.8*	*3.1*	*3.2*	*5.1*	*5.8*
Particles in Water	515	*523*	*1,190*	*788*	*-1.5*	*1.0*	*1.1*	*2.4*	*1.6*
Organisms in Water	54	*50*	*67*	*53*	*8.0*	*0.1*	*0.1*	*0.1*	*0.1*
TASTE AND ODOUR									
Chlorine	1,022	*1,105*	*1,986*	*1,458*	*-7.5*	*2.0*	*2.2*	*4.0*	*2.9*
Metallic	417	*539*	*1,285*	*1,358*	*-22.6*	*0.8*	*1.1*	*2.6*	*2.7*
Solvent/Fuel Taste/Smell	49	*54*	*107*	*42*	*-9.3*	*0.1*	*0.1*	*0.2*	*0.1*
Musty/Earthy	616	*558*	*1,035*	*588*	*10.4*	*1.2*	*1.1*	*2.1*	*1.2*
TCP/Chemical Taste/Smell	352	*457*	*1,102*	*283*	*-23.0*	*0.7*	*0.9*	*2.2*	*0.6*
OTHER CONTACT ABOUT WATER QUALITY									
Illness due to Water	151	*167*	*451*	*427*	*-9.6*	*0.3*	*0.3*	*0.9*	*0.9*
Other Contact	0	*0*	*0*	*73*	*-*	*0.0*	*0.0*	*0.0*	*0.1*
TOTAL CONTACTS ABOUT WATER QUALITY	**14,012**	***12,212***	***18,038***	***25,907***	***14.7***	***27.7***	***24.4***	***36.1***	***51.9***

Scottish Water received 14,012 consumer contacts relating to water quality equating to a contact rate of 27.7 per 10,000 population. This is a disappointing increase over the position in 2013 and it is driven by more consumer calls about discolouration. Other categories are substantially of the same order as last year.

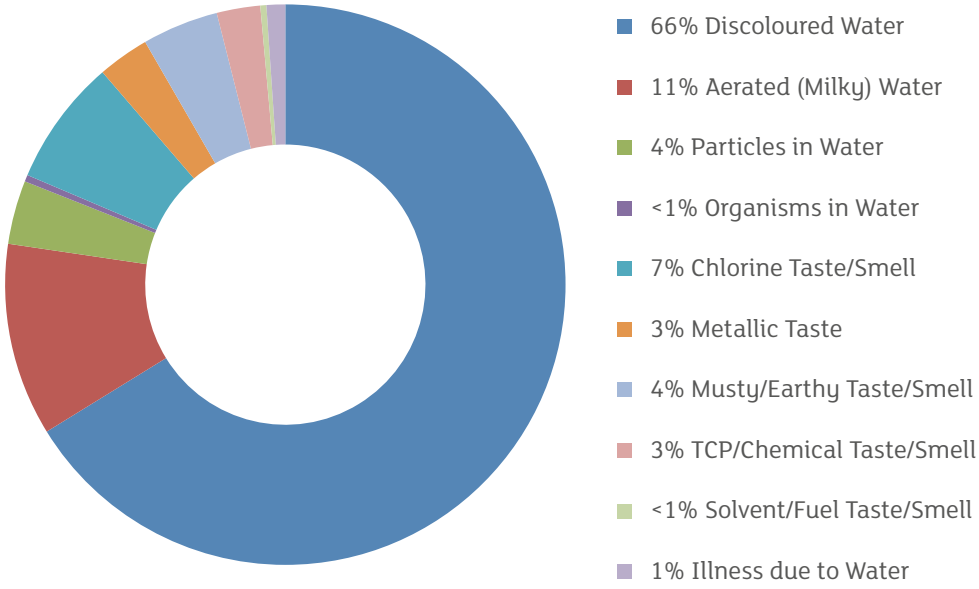


Fig. 3.4a_ Breakdown of consumer contacts by type

Figure 3.4a shows over 77% of calls were made in response to discoloured water and aerated (or milky) water. These categories are not only a reflection of problems related to the condition of the water supply network but they also are influenced by operational activity causing flow changes within the water mains i.e. operation of valves or burst mains. The diagram also shows the significant proportion (17%) of contacts relating to the taste or smell of the water supply causing concern to consumers.

Whilst it is acknowledged that the proportions of categories will shift as the overall numbers change, **Figure 3.4b** further illustrates the point in terms of the trends in key contact types. The downward trend has unfortunately been reversed this year through a significant increase in discolouration complaints. It is good to see the upward trend in taste and odour issues appears to have stabilised and is again in line with earlier years' experiences. Scottish Water must work harder however to address the various causes of taste and ensure satisfactory supplies are provided to consumers.

Again this year, over 40% of all taste and odour complaints are about chlorine - the level of complaints is two per 10,000, and this is the lowest seen over the past eight years. This is welcomed by DWQR but it is important that Scottish Water continues to review chlorine residuals in water supply systems to ensure these are appropriate and to identify opportunities to reduce the amount of chlorine being added whilst not compromising microbiological safety.

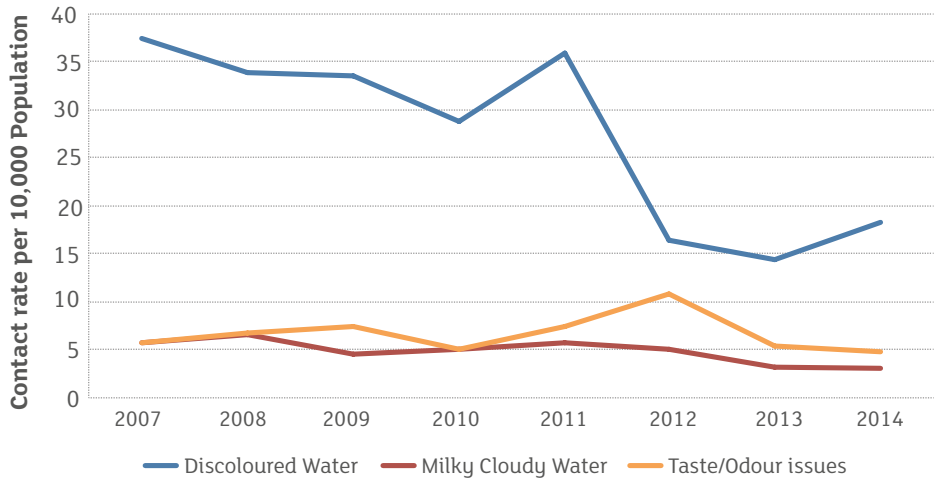


Fig. 3.4b_ Trend in key contact categories

The overall contact rate for Scotland in 2014 (from **Table 3.4a**) was 27.7 per 10,000. In geographic terms, the areas where most issues were raised by consumers are shown in **Figure 3.4c**. This chart shows the supply zones, ranked by contact rate.

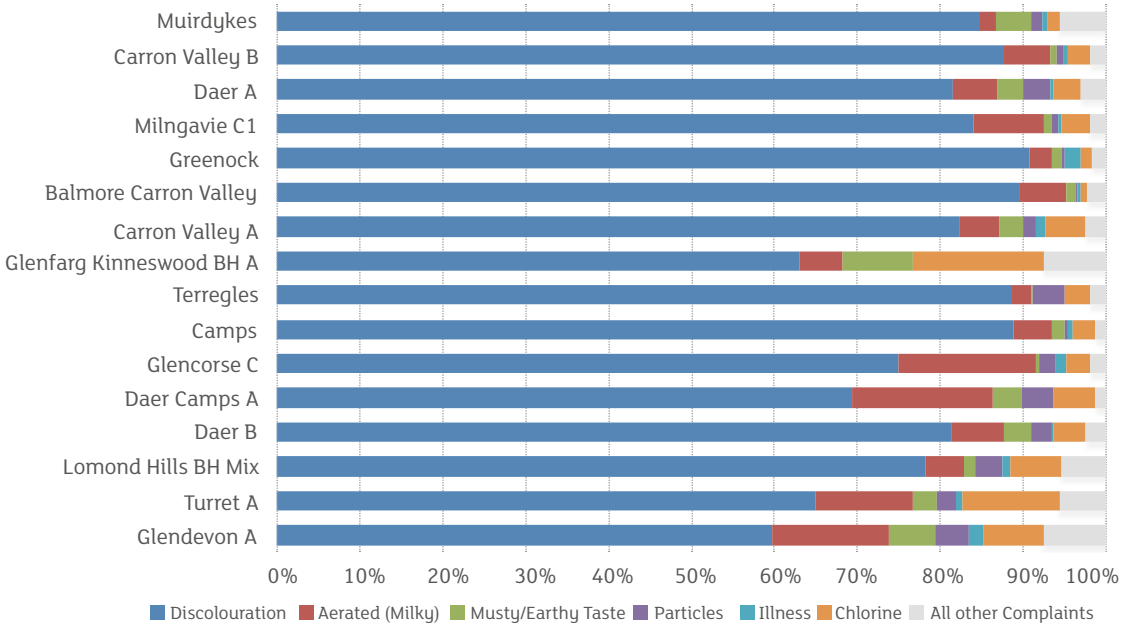


Fig. 3.4c_ Water Supply Zones With Most Water Quality Contacts

Muirdykes Supply Zone, in Renfrewshire, had almost five times the overall contact rate across Scotland, generating 133 contacts per 10,000 population. This zone has featured at the top end of the lists of zones causing most consumer concerns over the past four years. The majority of these complaints are of discoloured water, which is due to a known issue with the capability of the WTW to deal with manganese. Scottish Water has given an Undertaking to Scottish Ministers to address these problems. This can be viewed on the DWQR website http://www.dwqr.org.uk/media/8791/muirdykes-supply-zone-renfrewshire-august-2011.pdf

Carron Valley B zone closely follows in terms of contact rate but this zone recorded 1,013 consumer contacts, the greatest number in any zone, in 2014. The prime reason for consumers calling Scottish Water in this area, generating almost 60% of its calls, was a failure of a pressure reducing valve in the Denny area, causing a sequence of burst water mains. Together with the consequent temporary re-zoning of the area and the required valve operations in the network, it caused discolouration of the supply and other related water quality issues. The incident illustrates the importance of responsible management of valving operations on supply networks to minimise water quality issues for consumers.

This year there are three more zones than in 2013 which generated more than 200 consumer complaints for water quality, again reflecting the dissatisfaction with discoloured water supplies.

3.5_ CONSUMER CONTACTS TO DWQR

Scottish Water has a responsibility to investigate water quality complaints and supply issues, and the DWQR guides consumers to report any concerns to Scottish Water in the first instance to enable their investigation and resolution. Where consumers are dissatisfied with Scottish Water's response and have pursued a formal complaint with Scottish Water, the DWQR can carry out an investigation of the issues.

The DWQR is committed to ensuring consumer complaints are properly investigated and has an agreement with the Scottish Public Services Ombudsman (SPSO) on the arrangements and processes required to provide a fair and transparent assessment of water quality complaints.

Table 3.5a_ Consumer contacts received by DWQR

CONTACT CATEGORY	NUMBER OF CONTACTS				
	2014	2013	2012	2011	2010
APPEARANCE					
Discoloured Water	6	6	8	18	21
Aerated (Milky) Water	1	2	3	2	6
Particles in Water	1	2	2	5	4
Organisms in Water	1	0	0	0	4
TASTE AND ODOUR					
Chlorine	9	5	19	19	5
Metallic	0	2	2	3	1
Solvent/Fuel Taste/Smell	0	0	0	0	0
Musty/Earthy	0	2	0	2	3
TCP/Chemical Taste/Smell	0	1	1	2	6
OTHER CONTACT ABOUT WATER QUALITY					
Illness due to Water	2	2	1	8	6
Other Contact	3	10	10	5	3
TOTAL CONTACTS ABOUT WATER QUALITY	**23**	32	46	64	59
Public water supply issues & requests for information	23	27	42	56	60
Private water supply issues	16	12	7	16	5
General Enquiries to DWQR	37	21	37	17	26
Total Consumer Contacts to DWQR	**99**	***92***	***132***	***153***	***150***

Table 3.5a shows the various categories of consumer contacts received by the DWQR in 2014. Overall, 99 contacts were received. The overall number of contacts and, within that, the number of consumers with complaints about the public water supply, has significantly reduced in recent years and the level of contacts are of a similar level to last year. The key factor in the reduction is clearer guidance to consumers to make use of Scottish Water's formal complaints process to allow the company the opportunity to properly investigate and resolve issues.

DWQR carried out formal investigations of two complaints against Scottish Water in 2014. Both of these concerned complaints of taste in the water.

Case 1 – That the water had an unpleasant earthy/musty and chlorine taste, making it difficult to consume. DWQR found that Scottish Water had tried to help the consumer but had continually failed to investigate the complaint properly. The repeated sampling and provision of bottled water, while apparently responding to the consumer's immediate concerns, had done nothing to resolve the issue on a longer term basis and only served to antagonise the consumer. DWQR considers that provision of bottled water is appropriate until such time as sample data demonstrate that the water is safe to drink and there is no evidence of a significant taste or odour to the water. The continued provision of bottled water is likely to reinforce concerns that something is wrong. It was also of concern that, prior to DWQR's involvement, no investigation had been done of the consumer's property. The report from this visit, whilst failing to find a definitive cause of taste and odour issues, highlighted a number of potential issues that could cause such problems. DWQR made four recommendations in this case.

Case 2 – That Scottish Water had supplied water with a high chlorine content making it undrinkable, were providing incorrect information regarding the supply, incorrect information on chlorine levels and that they were unable to regulate the chlorine dosing properly at the treatment works. DWQR was satisfied that Scottish Water had responded speedily to calls from the consumer and had established that the supply met the regulatory requirements. A factor in the case was that the proximity of the consumer's property to the treatment works, which meant that the level of chlorine in the water was higher than that experienced by consumers elsewhere in the distribution system. DWQR however found the amount of chlorine in the supply was being maintained at a suitable level and found no evidence of misrepresentation of results. DWQR made two recommendations concerning communication and provision of guidance materials.

The full determinations are published on the DWQR website www.dwqr.org.uk

3.6_ EVENTS AND INCIDENTS

In 2014, 758 events were reported to the DWQR, of which 401 were raised in relation to sample failures or issues in distribution systems. 16 of these event notifications were declared incidents which translates to just over 3% of all incidents as occurring on water mains or private consumer distribution systems. Two were categorised as serious by DWQR and 11 as significant. The most common root cause in these were disturbance to flows within the water mains either as a consequence of burst pipes or through operational use of control valves. Scottish Water must examine their controls over operation of valves and the necessary flushing activities associated, to minimise water quality issues for consumers.

Figure 3.6a shows the breakdown of the water quality issues at the root of the events in the distribution systems across the country. It quite clearly illustrates the degree to which microbiological and iron parameters contribute to the overall numbers of events.

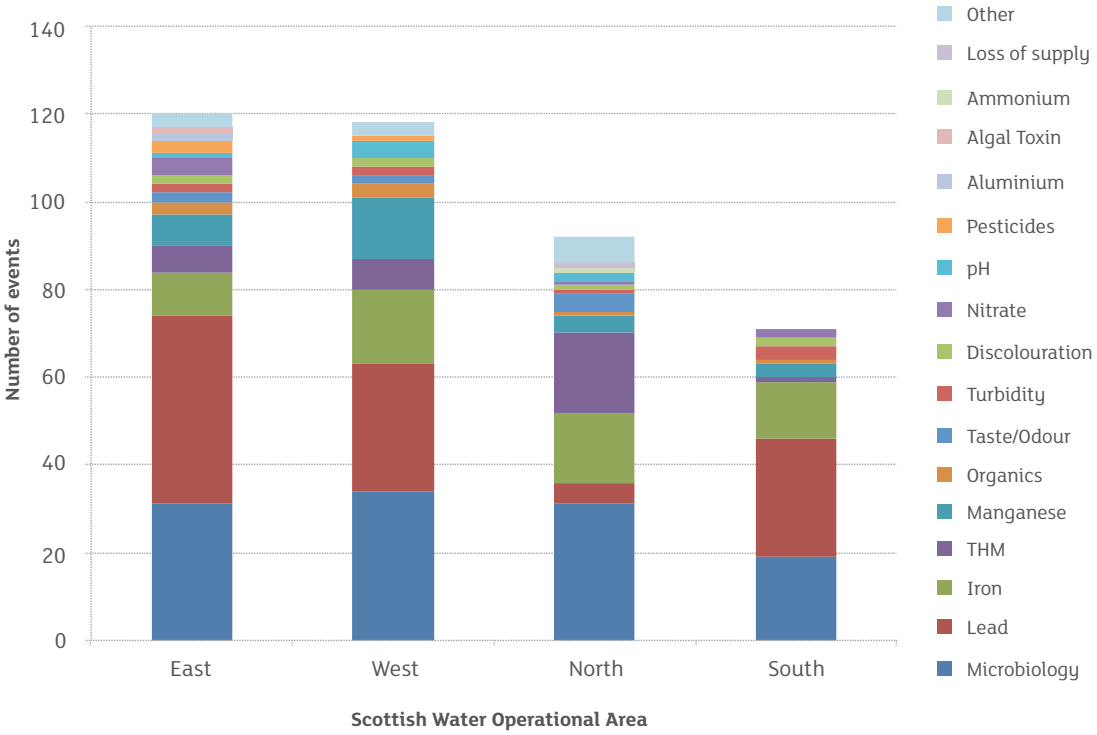


Fig. 3.6a_ Nature of Water Quality Events

Table 3.6a_ Location of Event Root Cause

FAILURE ELEMENT	EAST	WEST	NORTH	SOUTH	TOTAL NETWORK EVENTS	% OF NETWORK EVENTS
Network	41	56	35	30	162	40.4
Private / Domestic System	50	32	20	28	130	32.4
Treatment works	11	10	26	3	50	12.5
Storage point	1	0	1	2	4	1.0
Sampling	2	1	2	1	6	1.5
No Cause determined	8	16	6	7	37	9.2
Reporting error	7	3	2	0	12	3.0
Total	120	118	92	71	401	

Table 3.6a shows the element of the water supply chain to which the root cause of the failure was attributed. The table shows 12.5% are a direct consequence of some treatment issue which has had an impact within distribution. The most common attributable cause however is the condition of the water mains. Sample failures generally arise from the disturbance of deposits within the pipes which can be a reflection of the condition of the iron pipeline material but also of accumulations from historical treatment failures or process effectiveness.

In some cases it has not been possible to attribute a definite root cause to the event. The 9.2% of events, 37 in number, where it has not been possible to attribute the event to a specific element of the distribution system almost entirely concern microbiological failures of samples taken from consumer taps.

A description of all incidents is provided in Annex A and summaries of all incident investigations are published on the DWQR website www.dwqr.org.uk

The following are incidents of particular note, requiring significant investigation by DWQR:

Stornoway

As part of work to rehabilitate water mains in Stornoway town, a valve was operated at Airigh na Lic service reservoir in order to enable work to commence. This had the effect of unexpectedly restricting the flow of water to the pumps supplying the Marybank area of Stornoway, cutting off the supply of water. When this was realised, the valve was opened creating a surge effect that scoured deposits in water mains and led to approximately 3000 people receiving discoloured water in part of Stornoway.

Targeted flushing enabled water to be running clear within five hours. DWQR is of the opinion that it should have been clear to operational staff that such an activity carried risk, and steps should have been taken to minimise this risk. Scottish Water has changed the way in which the distribution system at the service reservoir operates to reduce the risk of a recurrence. A programme of flushing and assessment was subsequently undertaken in Stornoway Town to assess and prioritise the risk from discolouration. DWQR categorised this incident as significant.

Cumnock

During the investigation of a consumer complaint of a musty or earthy taste to the water supply within industrial premises near Cumnock in Ayrshire, Scottish Water had revisited the site to take further water samples for analysis. At this visit, the supply was noticeably more discoloured and had a fuel-like taste and odour initiating wider investigation which identified a cross connection between a pumped processing water supply and the incoming mains supply as being the likely source of the contamination. Earlier investigation of the complaint had established there were no complaints from neighbouring consumers indicating the problem was contained within the site. A subsequent full inspection of the site identified a number of Byelaws contraventions and a don't drink, cook or wash notice, was placed on the site to safeguard employees and visitors. The main supply remained isolated until full remedial works were completed in the site.

Whilst appropriate notifications within a reasonable timescale were made to health and regulatory stakeholders, DWQR was of the view there is a case for review of the alerting triggers and timescales for communications in such events. Scottish Water had previously inspected these industrial premises in 2006. Their Byelaws policy however states that for the degree of risk presented by this type of site, that inspection should be carried out every five years. This incident was categorised as significant by DWQR.

Daer Camps A Zone (Harthill)

A customer reported a taste and odour of diesel in their drinking water. On investigation the operator found a similar issue in a neighbouring property, and samples from a wide range of properties in the supply zone showed the presence of a number of polyaromatic hydrocarbons (PAHs) and failures of the standards for benzo(a)pyrene and total PAH. The source of PAH in drinking water is usually coal tar lining, which was historically used to line pipes to protect them from corrosion. Scottish Water were undergoing a programme of planned mains rehabilitation in Harthill during this time and it is likely that increased flows during flushing and swabbing operations during the works disturbed sediments and the coal tar lining in the lower parts of the network. DWQR found this to be the root cause of the taste and odour complaint and of the failures of water quality parameters.

DWQR was satisfied that Scottish Water's investigation and remediation was rapid and thorough, with extensive flushing and sampling of the system carried out over a period of two and a half weeks to restore water quality. Scottish Water fast-tracked laboratory samples and the customer reporting the problem was kept updated on progress throughout the duration of the incident. However DWQR had concerns about the sufficiency of sampling at the start of the incident. DWQR concluded that Scottish Water must review their sampling protocol in response to potential hydrocarbon contamination events. This incident was categorised as significant.

SECTION 4 AUDIT & INSPECTION

4.1_ AUDIT AND INSPECTION

An important part of DWQR's scrutiny role is to audit and inspect activities undertaken by Scottish Water. DWQR may choose to inspect any aspect of Scottish Water's activities that could affect water quality. Inspections commonly undertaken include water treatment works, storage points, distribution system activities, response to consumer water quality issues and analytical services. Auditing takes place against the requirements of the regulations, as well as water industry best practice. DWQR also audits the completion of investment projects. Typically site visits will be undertaken prior to DWQR signing off the larger water treatment works projects and DWQR will audit a selection of Scottish Water's self-certification projects.

The inspection process provides a number of benefits:

- It enables DWQR to verify that Scottish Water are 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 among Scottish Water staff
- It enables verification of the delivery of investment work
- DWQR can build an awareness of common trends, risks or deficiencies across Scotland and use these to inform future policy and guidance.

Fig 4.1_ A service reservoir inspection in the West of Scotland

Sites to be inspected are selected 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. In the past, DWQR has inspected the procurement of services affecting water quality and actions to complete DWQR recommendations.

DWQR uses standardised inspection templates to ensure consistency between inspectors, 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 in order to drive consistency and spread best practice.

Where issues are noted during an inspection these are recorded as recommendations that are tracked and followed up. If common themes are identified, these are progressed centrally with senior Scottish Water staff. Elements of best practice are also highlighted when these are observed. Scottish Water always 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.

In 2014, DWQR completed four inspections of WTW. As always, Scottish Water staff operated their plants with a high degree of professionalism and pride and many examples of best practice were noted. As the inspections were risk or incident triggered, particular attention was paid to the deficiency that had triggered the audit, whether this was asset based or procedural.

The greatest number of recommendations were centred around process control, especially in terms of the ability of the process to continue to operate under certain circumstances, and the monitoring of water quality parameters. Most sites visited were maintained and operated to a high standard, but notable issues that DWQR identified include:

- The need for urgent review of the future of one treatment works, and the requirement to replace it with a supply that meets modern standards of quality and resilience;
- The requirement at a treatment works for the urgent investigation and improvement of disinfection;
- Deficiencies in raw and treated water quality monitoring across several of the treatment works audited, both on-line monitoring and manual sampling, as well as by-product specification. This was not only to give confirmation of water quality, but also to inform treatment process operation;
- Process control issues and development of procedures for response to process alarms;
- Recommendations for improvements to chemical storage and chemical dosing;
- Better understanding of raw water sources, their quality and security.

Table 4.1_ Water Treatment Works

LOCATION	DATE	REASON FOR AUDIT	NO. OF RECOMMENDATIONS
Camps WTW (Lanarkshire)	January 2014	Risk based	5
Herricks WTS (Aberdeenshire)	March 2014	Risk based	7
Spey Badentinan WTW (Moray)	March 2914	Risk based	5
Craighead WTS (Aberdeenshire)	March 2914	Risk based	3

Auditing Torra WTW, Islay

Two distribution audits were undertaken in 2014 – one on a service reservoir in the Lothians, and on a distribution system activity in Highland. These are shown in **Table 4.2**. During the latter inspection, the most significant recommendation concerned the correct make up of hypochlorite spray used to disinfect equipment and fittings.

Table 4.2_ Distribution Systems

LOCATION	DATE	REASON FOR AUDIT	NO. OF RECOMMENDATIONS
Humble SR (Lothian)	February 2014	Risk based	0
Dingwall PWSZ (Highland)	October 2014	Risk based – Mains opening	2

Seven investment audits were undertaken during 2014. Of the four sign off audits, three were satisfactory and one at Kenmore boreholes required further work on turbidity monitoring and the provision of *Cryptosporidium* monitoring data.

Table 4.3_ Investment

LOCATION	SOLUTION	REASON FOR AUDIT
Glenlatterach WTW	Phosphate dosing	Sign Off
Turriff WTW	Phosphate dosing	Sign Off
Badentinan WTW	Phosphate dosing	Sign Off
Kenmore WTW	Continuous turbidity monitoring with flow diversion	Sign off
Dalwhinnie, Glenlatterach WTWs	Security measures	Self-certification audit

ANNEXES

ANNEX A – SUMMARY OF EVENTS AND INCIDENTS

Scottish Water is required to tell 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	587	118	43	8	2

The following tables detail the significant and serious events declared as incidents within treatment works and distribution systems.

Water Supply Zone

SUPPLY ZONE	LOCATION	DATE OF INCIDENT	CAUSE OF INCIDENT	CATEGORY
Glencorse C	Colinton	Jan-14	Flow disturbance	Significant
Stornoway Western Isles	Stornoway	Mar-14	Flow disturbance	Significant
Afton	Cumnock	May-14	Back syphonage	Significant
Daer Camps A	Harthill	Jun-14	Pipe material	Significant
Badentinan	Elgin	Aug-14	Inadequate treatment (no process)	Significant
Invercannie	Banchory	Aug-14	Inadequate treatment (no process)	Serious
Killylour	Dumfries	Aug-14	Inadequate treatment (no process)	Significant
Lomond Hills BH	North East Fife	Sep-14	Flow disturbance	Major
Carron Valley B	Denny & Bonnybridge	Sep-14	Flow disturbance	Significant
Lintrathen	Forfar	Sep-14	Burst main	Significant
Balmore	Airdrie	Oct-14	Flow disturbance	Significant
Balmore	Airdrie	Oct-14	Flow disturbance	Significant
Picketlaw	Eaglesham	Oct-14	Flow disturbance	Significant
Lomond Hills	North East Fife	Oct-14	Inadequate treatment (no process)	Significant
Lomond Hills BH Mix	North East Fife	Oct-14	Inadequate treatment (no process)	Serious
Daer Camps A	Bothwell & Hamilton	Nov-14	Flow disturbance	Significant
Lomond Hills	North East Fife	Dec-14	Inadequate treatment (no process)	Significant

Storage points

STORAGE RESERVOIR (SR)	LOCATION	DATE OF INCIDENT	CAUSE OF INCIDENT	CATEGORY
Rosemarkie	Rosemarkie	May-14	Pipeline Repair	Serious
Drymen	Drymen	Jul-14	Flow disturbance	Significant
Muirheads	Arbroath	Sep-14	High chlorine	Major
Balreavie	North East Fife	Sep-14	Flow disturbance	Serious

Water Treatment Works

SITE	DATE OF INCIDENT	CAUSE OF INCIDENT	CATEGORY
Castle Moffat	Jan-14	Coagulation Failure	Significant
Glenfarg	Feb-14	Clarification Process Failure	Serious
Milngavie	Feb-14	Sampling Failure	Significant
Tweedsmuir	Feb-14	GAC Media Failure	Significant
Savalbeg	Apr-14	Coagulation Failure	Significant
Bradan	Apr-14	Coagulation Failure	Significant
Applecross	May-14	Sampling Failure	Significant
Whitehillocks	May-14	Coagulation Failure	Significant
Penwhapple	Jun-14	Disinfection Process Failure	Significant
Lochenkit	Jun-14	Disinfection Process Failure	Significant
Whitehillocks	Jul-14	Coagulation Failure	Significant
Torra	Aug-14	Coagulation Failure	Significant
Neilston	Aug-14	Coagulation Failure	Significant
Whitehillocks	Aug-14	Coagulation Failure	Significant
Whitehillocks	Aug-14	Coagulation Failure	Significant
Spey Badentinan	Aug-14	Membrane Integrity	Serious
Spey Badentinan	Aug-14	Membrane Integrity	Serious
Spey Badentinan	Aug-14	Membrane Integrity	Serious
Mannofield	Aug-14	Coagulation Failure	Significant
Mannofield	Aug-14	Coagulation Failure	Significant
Stoer	Sep-14	GAC Media Failure	Significant
Bradan	Sep-14	Coagulation Failure	Significant
Invercannie	Sep-14	Disinfection Process Failure	Significant
Kilberry	Oct-14	Disinfection Process Failure	Significant
Whitehillocks	Oct-14	Coagulation Failure	Significant
Invercannie	Nov-14	Coagulation Failure	Significant
Craignure	Nov-14	Inadequate Treatment	Significant
Craignure	Nov-14	Inadequate Treatment	Significant
Craignure	Nov-14	Inadequate Treatment	Significant
Burncrooks WTW	Dec-14	Coagulation Failure	Significant
South Moorhouse WTW	Dec-14	Coagulation Failure	Significant
Picketlaw WTW	Dec-14	Coagulation Failure	Significant

ANNEX B – AUDIT AND INSPECTION

It is a key part of DWQR's role to inspect Scottish Water's activities and assets that could impact upon water quality. When conducting an inspection, DWQR is auditing against the requirements of the Regulations and water industry best practice. In all cases, the report and recommendations made are passed to Scottish Water for comment before a summary of the audit report is published on the DWQR website. Actions arising from inspection recommendations are tracked to ensure that they are completed satisfactorily. In 2014, DWQR completed the following inspections:

Water Treatment Works

LOCATION	DATE	REASON FOR AUDIT	NO. OF RECOMMENDATIONS
Camps WTW (Lanarkshire)	January 2014	Risk based	5
Herricks WTS (Aberdeenshire)	March 2014	Risk based	7
Spey Badentinan WTW (Moray)	March 2014	Risk based	5
Craighead WTW (Aberdeenshire)	March 2014	Risk based	3

Distribution Systems

LOCATION	DATE	SCOPE OF AUDIT	NO. OF RECOMMENDATIONS
Humble SR (Lanarkshire)	February 2014	Risk based	0
Dingwall PWSZ (Lanarkshire)	October 2014	Risk based – Mains opening	2

Investment Schemes

LOCATION	SOLUTION	REASON FOR AUDIT
Glenlatterach WTW	Phosphate dosing	Sign Off
Turiff WTW	Phosphate dosing	Sign Off
Badentinan WTW	Phosphate dosing	Sign Off
Kenmore WTW	Continuous turbidity monitoring with flow diversion	Sign Off
Dalwhinnie, Glenlatterach WTWs	Security measures	Self-certification audit

ANNEX C – UNDERTAKINGS AND ENFORCEMENT NOTICES

Where water supplies do not comply with the required water quality standard, there are a number of mechanisms available to DWQR to ensure that the necessary steps are taken to achieve compliance. These are set out in DWQR's Enforcement Policy, which is published on the DWQR website

Undertakings

In general, the DWQR will seek to secure compliance with legislation through co-operation, discussion and offering advice. This process of co-operation and discussion may result in Scottish Water giving a legally binding Undertaking to Scottish Ministers under the provision of Section 76E of the Water (Scotland) Act 1980, setting out the steps that Scottish Water will take to secure compliance with the legislation. Such Undertakings provide a visible commitment from Scottish Water that the necessary improvement will be made.

In 2014, there were five on going Undertakings, listed below.

Muirdykes water treatment works and supply zones – Manganese
Bradan water treatment works and supply zones – Manganese* and THMs
Amlaird treatment works and supply zones – Iron* and THMs
Craignure treatment works – *Cryptosporidium*
Tullich treatment works – *Cryptosporidium* and THMs

*These Undertakings are in the process of being re-drafted

Enforcement Notices

When DWQR has evidence that Scottish Water has contravened a drinking water quality duty and the contravention is likely to recur *and* Scottish Water does not appear willing to take timely steps to rectify the situation, DWQR may serve an Enforcement Notice on Scottish Water under Section 10 of the Water Industry (Scotland) Act 2002. Such an Enforcement Notice must set out specific actions to be taken by Scottish Water within specified timescales. Failure to complete such actions by the due date is a criminal offence under Section 12 (5) of the Act.

In 2014 there were no active Enforcement Notices.

ANNEX D – SUMMARY OF IMPROVEMENT PROGRAMMES

Scottish Water has been directed by Scottish Ministers to undertake a number of different projects to improve and protect drinking water quality across Scotland during the period of 1 April 2010 to 31 March 2015. These projects include: water treatment works improvements; water mains rehabilitation; studies assessing future rehabilitation requirements; surveys to confirm numbers of lead communication pipes; replacement of lead communication pipes and installation of backflow protection devices. Scottish Water's progress with this investment is monitored by the Scottish Government Outputs Monitoring Group, and DWQR is a member of this group. The Outputs Monitoring Group provides Scottish Ministers with a quarterly report of progress.

The summary table below shows the water treatment works improvement schemes which were signed off as complete during 2014.

WTW	DRIVER	SOLUTION
Peninver	*Cryptosporidium*	Mained out and area supplied from an alternative WTW
Garve	*Cryptosporidium*	Mained out and area supplied from an alternative WTW
Glenlatterach	Lead	Phosphate dosing installed
Badentinan	Lead	Phosphate dosing installed
Turriff	Lead	Phosphate dosing installed
Rochomie	Lead	Mained out and area supplied from an alternative WTW
Carsphairn	Disinfection Index	Optimisation of disinfection system
Oykel Bridge	Disinfection Index	New disinfection dosing system

ANNEX E – THE REGULATORY FRAMEWORK

The regulatory standards for drinking water quality in Scotland largely stem from European Directives. These standards are based on Guidelines values, developed by the World Health Organisation, to protect public health.

Our key domestic water quality legislation includes:

Water (Scotland) Act 1980 (as amended)

- Scottish Water must supply wholesome water for domestic purposes. It is a criminal offence to supply water unfit for human consumption;
- Scottish Ministers must take enforcement action against Scottish Water if it fails in its duty to supply wholesome water (as defined in the relevant regulations) unless the failure is trivial or Scottish Water is complying with a legally binding undertaking to remedy the matter; and
- local authorities must take appropriate steps to keep themselves informed about the wholesomeness of public water supplies in their area and notify Scottish Water if not satisfied.

The Water Supply (Water Quality) (Scotland) Regulations 2001

- transpose the requirements of Council Directive 98/83/EC on the quality of water intended for human consumption into Scottish legislation;
- define wholesomeness by setting standards for 40 parameters and a further 11 indicator parameters;
- set and define the supply zone as the basic unit for quality monitoring;
- specify sampling requirements for samples taken at taps within zones, at service reservoirs and at WTW; and
- require Scottish Water to publish an annual report and keep a public register of water quality in its area.

Water Industry (Scotland) Act 2002

- created the post of Drinking Water Quality Regulator for Scotland (DWQR);
- set out responsibility for enforcing The Water Supply (Water Quality) (Scotland) Regulations 2001;
- defines DWQR's independent status;
- defines DWQR power to obtain information, power of entry or inspection and power of enforcement; and

- DWQR also has emergency powers to require a water supplier to carry out works to ensure quality of water supplied is safe for public consumption.

The Water Quality (Scotland) Regulations 2010

- further transpose the requirements of Directive 98/83/EC most particularly in respect of water quality failures which are attributable to the domestic distribution system in establishments and premises where water is supplied to the public;
- require local authorities to investigate such water quality failures to determine their cause;
- instruct remedial action through the service of a notice on the person who owns, or is responsible for, the domestic distribution system;
- ensure that affected consumers are notified of any risk to their health.

The 2010 Regulations also make a number of technical amendments to The Water Supply (Water Quality) (Scotland) Regulations 2001 and The Private Water Supplies (Scotland) Regulations 2006 to:

- create a duty to minimise contamination from disinfection by-products and to verify the effectiveness of the disinfection process.

The *Cryptosporidium* (Scottish Water) Directions 2003

- provide for more widespread testing for *Cryptosporidium* to provide data about background levels in water supplies;
- provision put in place for *Cryptosporidium* sampling at all water treatment works; every supply in Scotland must be tested based on the assessed risk and the flow through the works (at least once a month).

The Scottish Water (Objectives for 1 April 2010 to 31 March 2015) Directions 2009

In support of the Government's objective for a healthier Scotland, the Scottish Ministers issued Directions to Scottish Water to deliver a number of specified objectives in the period 1 April 2010 to 31 March 2015. In relation to drinking water quality these include:

- delivering appropriate treatment solutions to a number of sites to reduce the risk of *Cryptosporidium* from entering the supply system;
- commencing a programme of water mains rehabilitation that will reduce the risk of water quality being degraded by the condition of the distribution system when in steady state flow conditions;
- delivering the necessary improvements to ensure that water supply zones are protected against conditions that have a probability of a 1 in 40 year return period; and
- establishing water safety plans, as promoted by the World Health Organisation, for all public drinking water supplies.

ANNEX F – INDEX OF INFORMATION LETTERS ISSUED DURING 2014

Information Letter number	Title
Public Supply	
2014/1	Monitoring of Radioactivity in Scottish Drinking Water
2014/2	Not issued
2014/3	Update on DWQR Requirements for the Reporting of Water Quality Events
Private Supply	
2014/1	Method Requirements for Analysis of Private Water Supplies
2014/2	Updated PWS Financial Implications – Reimbursement Claims Under S47 of the Local Government in Scotland Act 2003

Copies of these letters are available on the DWQR website:
www.dwqr.org.uk

ANNEX G – CATEGORIES OF DRINKING WATER QUALITY CONTACTS

Appearance of the Water

Discoloured Water

Water with a discernible taint or colour caused by suspended or dissolved matter. Two of the most common causes are a yellow taint caused by dissolved organic matter arising from peat in upland sources and more general orange, brown or black discolouration caused by suspended particles of iron (orange/brown) and manganese (black). Iron discolouration may occur through natural iron present in the raw water passing through inadequate treatment or from corrosion of cast iron distribution mains. Manganese is present in some raw waters and may not be removed if treatment is inadequate.

Milky Cloudy Water

Water which has a milky appearance is caused by tiny bubbles of entrained air which dissolve in the water under pressure but come out of solution at the consumer's tap. A number of causes are possible including burst mains, malfunctioning pumps and consumer stop taps that are only partially open. If air is the cause of the milky water, the cloudy appearance will clear in a glass of water from the bottom up.

Particles in Water

Visible particulate matter in water which is otherwise not discoloured. This can be caused by corrosion of iron mains or deposits of sand, grit or other material present in the main being re-suspended following a change in the flow in the main.

Organisms in Water

This category includes complaints of insects or other animals in the water supply. Most complaints arise where an insect has crawled up a tap or is present in the sink. Very occasionally water systems can contain animals which may arise from the raw water, from treatment works or within the water mains themselves. This is extremely rare, however organisms such as midge larvae (*Chironomid*) or water shrimp (*Aesellus*) have occasionally been found in domestic supplies.

Taste or Smell of the Water

Chlorine Taste/Smell

The use of chlorine as a disinfectant ensures the water supply remains safe as it travels through the sometimes extensive water mains system and private pipework to consumers. Chlorine dissipates as it travels through water mains, so levels leaving the treatment works will necessarily be higher than those at the ends of the system and some consumers will experience a higher level than others, depending upon their location. Excess residual chlorine can result in taste and smells but these should dissipate if the water is left to stand in the fridge for a few hours. It will also not be present after boiling. Scottish Water should keep chlorine concentrations under review to limit taste and odour issues with the provision that the safety of the water supply always remains of paramount importance.

Metallic Taste

Metallic tastes may arise from an excess of iron, aluminium or other metal dissolved in the water, although normally there will also be visible discolouration.

Solvent/Fuel Taste/Smell

This is not a common problem and if it arises it should be investigated immediately. Possible causes include spillages of petrol or hydrocarbons that have percolated through the soil and penetrated the plastic water main.

Musty/Earthy Taste/Smell

Musty or earthy tastes can arise due to naturally occurring compounds present in raw waters that have not been removed by the treatment process. Geosmin is one such compound commonly associated with earthy/musty tastes. Complaints are more common in the summer months when biological activity is highest – algal blooms in raw water sources are common causes of widespread musty tastes.

TCP/Chemical Taste

Sometimes consumers report that their drinking water has an unusual taste. Such tastes can be hard to describe, but a common description is TCP, medicinal or chemical. This can have a number of causes, but a common cause is where the small amount of chlorine added to the water to keep it safe reacts with phenol in plastics and rubbers in household plumbing and appliances to produce harmless compounds that have a very strong taste and smell that persists in cold and boiled drinks. Washing machine and dishwasher hoses, tap washers and kettles have all been shown to cause the problem under certain circumstances. The use of British Standard approved appliances and fittings will prevent the problem.

Other categories

Illness due to Water

Illnesses caused by public drinking water supplies are extremely rare in the UK as the quality of water is so high. Occasionally, consumers have concerns that their water supply is affecting their health in some way, but usually Scottish Water is able to demonstrate that the water is not the cause. DWQR expects Scottish Water to take all such concerns very seriously indeed, to investigate each contact very thoroughly and sample appropriately to demonstrate that the water supplied is wholesome. It is also expected that Scottish Water will provide reassurance to consumers and assist them by providing information on the quality of their water supply that they can discuss with their doctor if appropriate.

Other

Scottish Water receives a small number of contacts that do not easily fit into any other category. These may include other tastes and odours, or issues relating to lead plumbing and fungal growth on bathroom fittings.

ANNEX H – STATISTICAL METHODS USED IN THE REPORT

Water Quality Compliance Data for Local Authority Areas

In order to present drinking water quality data by local authority area, it has been necessary to report data for the group of supply zones within that area. Water supply zone boundaries do not fit local authority boundaries exactly, so the data for any supply zone which falls wholly or partly into the local authority area has been included.

This approach means that data from some supply zones is included twice or more in the Local Authority Area tables. For example, the same data for Alnwickhill B supply zone is included in the sections for East Lothian, Midlothian and City of Edinburgh.

Zonal Compliance

Zonal compliance is simply the percentage of samples meeting the PCV for that parameter.

Mean Zonal Compliance

Mean zonal compliance (MZC) for an area is built up from zonal compliance figures for individual parameters in individual supply zones. This is a helpful tool when considering water quality at national, regional and local level as it provides a simple means of summarising drinking water compliance and comparing year on year performance. It is this measure which is used as the overall measure of drinking water quality by DWI for companies in England and Wales and it allows us to compare national performance. It uses only the 40 parameters that are listed in Schedule 1 of the Water Supply (Water Quality) (Scotland) Regulations 2001 for which there is a numerical value.

All parameters are weighted equally in the calculation but the sheer number of pesticide determinands has the potential to skew the Mean Zonal Compliance calculation by placing undue weight on pesticide analysis. For that reason, results for the individual pesticides not specifically mentioned in Schedule 1 of the Regulations have been pooled to produce a single “All Pesticides” parameter. The large number of different pesticides analysed every year is determined using a risk assessment process to define specific sampling requirements in each supply zone.

MZC can be quite variable year on year as it can significantly deteriorate should a parameter fail in a very small zone sampled only once per year – effectively giving 0% compliance for that zone. This is a particular issue in Scotland, some of the water supply zones are very small, serving populations in single figures. Regulatory sample frequencies are based on population, hence sampling for certain parameters in these zones is infrequent, with perhaps only two samples being taken for each parameter per year. If one of these samples fails, this will adversely affect mean zonal compliance to a much greater extent than a sample failure in a large supply. For this reason the measure of overall water quality compliance at consumers’ taps is also calculated and used to report year on year comparative performance.

Overall Quality Compliance

The Overall Compliance for Scotland as measured at consumers' taps is simply the number of samples taken which met the required standards for parameters which have a numeric value in Schedules 1 and 2 of the Regulations.

Distribution Maintenance Index

The Distribution Maintenance Index (DMI) is the same as the Operational Performance Index (TIM) used in previous DWQR reports. It is used to reflect the performance of the distribution system for a zone or collection of zones, and is simply the arithmetic mean of the MZCs for turbidity, manganese and iron for the zone.

Worked Examples

Zonal Compliance

The zonal compliance for iron for a notional supply zone, Zone 1, is calculated as follows:

	NO. SAMPLES TAKEN FOR IRON	NO. SAMPLES FAILING	ZONAL COMPLIANCE (IRON)
Zone 1	52	2	96.15

Mean Zonal Compliance

In order to calculate the MZC for iron for a group of 10 zones which include Zone 1, the arithmetic mean of all the zonal compliances for iron is taken.

Zone 1	96.15
Zone 2	98.6
Zone 3	100
Zone 4	100
Zone 5	100
Zone 6	100
Zone 7	100
Zone 8	100
Zone 9	100
Zone 10	100
MZC	99.48

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