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Public Health England

Drinking Water Safety

Guidance to Health and Water Professionals

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Foreword

10 September 2020

In 2007 there was a major water supply incident involving the loss of water supplies to 160,000 properties in Cheltenham, Gloucester, Tewkesbury and a large part of rural Gloucestershire due to the waterworks being flooded by the River Severn. Subsequent to this, and other incidents, national level discussions between the Drinking Water Inspectorate (DWI) and the Public Health bodies in 2009 led to the first agreement to prepare and publish joint guidance to health and water professionals in support of drinking water quality risk assessments and the issuing of consumer protection advice.

In developing this guidance it was recognised the need to set out for health professionals the structure and legal framework of the water industry in England and Wales, and to describe the arrangements in place for securing the quality and safety of drinking water on a day-to-day basis. This position has been reinforced since 2009 with two further significant incidents where DWI and Public Health England (PHE) were instrumental in decisions that were made at the time and in the subsequent investigations. The first of these incidents was at Alderney water treatment works, (Bournemouth Water) where an increase in cryptosporidiosis in the community in 2013 was identified by PHE and investigated by the DWI who proved this to be linked to the water supply. The second was in 2015 where the detection of *Cryptosporidium* in water leaving Franklaw works, operated by United Utilities, resulted in a boil water notice to more than 700,000 consumers. Learning from these events and other legislative and organisational changes have led to this updated publication.

It is against this background that consultants in health protection, and other health professionals, may be called upon to give public health advice to the water industry and local government on consumer protection in relation to a water supply incident. This information will provide health professionals with useful context to the annual Chief Inspectors DWI publication, *Drinking Water*, setting out the annual results of drinking water tests and documenting the learning from water quality incidents.
In their day-to-day role, water quality scientists in the water industry work closely with health professionals in PHE, Public Health Wales (PHW) and local authorities. We consider the maintenance of sound working relationships to be very important in the identification as well as the delivery of effective and timely responses to water quality

incidents and emergencies. This guidance, together with Water Supply Risk Assessments (based on WHO Water Safety Plan Methodology), should form the basis of regular dialogue at local level to develop collective knowledge, understanding and trust.

In the preparation of this guidance it has been uppermost in our mind that the safety of drinking water in England and Wales is something the public is able to take for granted, because the day-to-day water supply arrangements in place are comprehensive and demonstrably based on sound science with a fully transparent system of independent scrutiny and appropriate sanctions in place. This guidance should be incorporated into existing training regimes and included in water supply and public health operating and emergency management procedures.

Marcus Rink
Chief Inspector of Drinking Water
Drinking Water Inspectorate

David Rhodes
Director Environmental Public Health
Public Health England.

1. Introduction

This document has been developed jointly by the Drinking Water Inspectorate (DWI) and Public Health England (PHE). It is intended to inform all health professionals, which includes, Consultants in Health Protection (CHPs) and the Environmental Health Officers and Practitioners (EHOs and EHP) within Local Authorities about the structure and legal framework of the water industry in England. It also explains when and how these professionals are likely to be called upon to give health protection advice about drinking water quality to the water industry, local authorities, consumers and DWI.

For cross border issues please note that this document has two versions published individually for England and Wales. In the event of a cross border incident it is recommended that both documents are used for guidance.

2. The Legal Framework

2.1. Drinking Water Inspectorate

The DWI is the drinking water quality regulator for England and Wales. It was formed in 1990 on the privatisation of the water industry. It is part of the Department for Environment, Food and Rural Affairs (Defra), but its Chief Inspector is appointed by the Secretary of State for Environment, Food and Rural Affairs (in England) and separately by Welsh Ministers in Wales. The overarching objective of DWI is to maintain public confidence in the safety and quality of public water supplies through the exercise of its powers of reporting, audit, inspection, enforcement and prosecution. The DWI also has a role in providing both governments with advice on water supply and quality matters.

The regulatory framework for water supplies in England and Wales is set out in the Water Industry Act 1991 (WIA). The 1991 WIA was amended by the Water Act 2003 and the Water Act 2014. The Act defines the powers and duties under which DWI operates and also the duties of water companies and licensees. Under the 1991 Act the authorities responsible for regulating the quality of public supplies are the Secretary of State for Environment, Food and Rural Affairs (in England) and Welsh Ministers. DWI's website http://www.dwi.gov.uk holds the relevant legislation.

Confirmation of the details of the statutory duties of water companies and the powers of the Chief Inspector are detailed below.

2.2. Public Water Suppliers

Public water supplies in England and Wales are provided by a number of water suppliers.

Water companies operating the public water networks hold appointments as water suppliers, and those operating the public wastewater networks hold appointments as sewerage service suppliers, for the purposes of the WIA 1991. They supply water and wastewater services direct to household customers (and in some cases to non-household customers) who are connected to their networks. There are currently:

- 11 regional water and sewerage suppliers
- 6 regional water only companies,
- 9 small water and sewerage suppliers

A full list is available at https://www.ofwat.gov.uk/regulated-companies/ofwat-industry-overview/licences/

Since 1 April 2017, holders of new water supply and/or sewerage licences (WSSL) can provide supplies of water and sewerage services to eligible non-household premises. Some licensees may be limited to providing water supplies or sewerage services to their own sites and those of persons associated with them (known as self-supply). Water supply licensees in England can currently have:

- A retail authorisation: this allows the licensee to supply water to non-household premises using the public water networks operated by water suppliers whose areas are wholly or mainly in England.

- A wholesale authorisation: this currently allows the licensee to introduce water into the public water networks of water suppliers whose areas are wholly or mainly in England in order to supply the licensee's own customers if their non-household premises consume at least 5 megalitres of water a year.

There are currently over 40 retail authorisations across England and Wales whereby the licensee provides retail services such as; billing, meter reading, customer enquiries, customer side water efficiency measures. A full list is available at:
https://www.ofwat.gov.uk/regulated-companies/ofwat-industry-overview/licences/

Licensees are under the control of Ofwat, the economic regulator for the water and sewerage industry in England and Wales. Ofwat's main duties are to:

- Further the consumer objective to protect the interests of consumers, wherever appropriate by promoting effective competition

- Secure that water companies (meaning water and sewerage suppliers) properly carry out their statutory functions

- Secure that water companies can (in particular through securing reasonable returns on their capital) finance the proper carrying out of their statutory functions

- Secure that water supply licensees and sewerage licensees properly carry out their licensed activities and statutory functions

- Further the resilience objective to secure the long-term resilience of water companies' water supply and wastewater systems; and to secure that they take steps to enable them, in the long term, to meet the need for water supplies and wastewater services.

The quality and quantity of water resources (groundwater, rivers, streams, lakes, and raw water reservoirs) is regulated by the Environment Agency (EA), a non-departmental public body of the Department of Environment, Food and Rural Affairs. All water regulators (DWI, Ofwat, and EA) have separate duties, but they co-operate over matters of common interest through Memoranda of Understanding. More information can be found at: http://www.environment-agency.gov.uk/ and http://www.ofwat.gov.uk/.

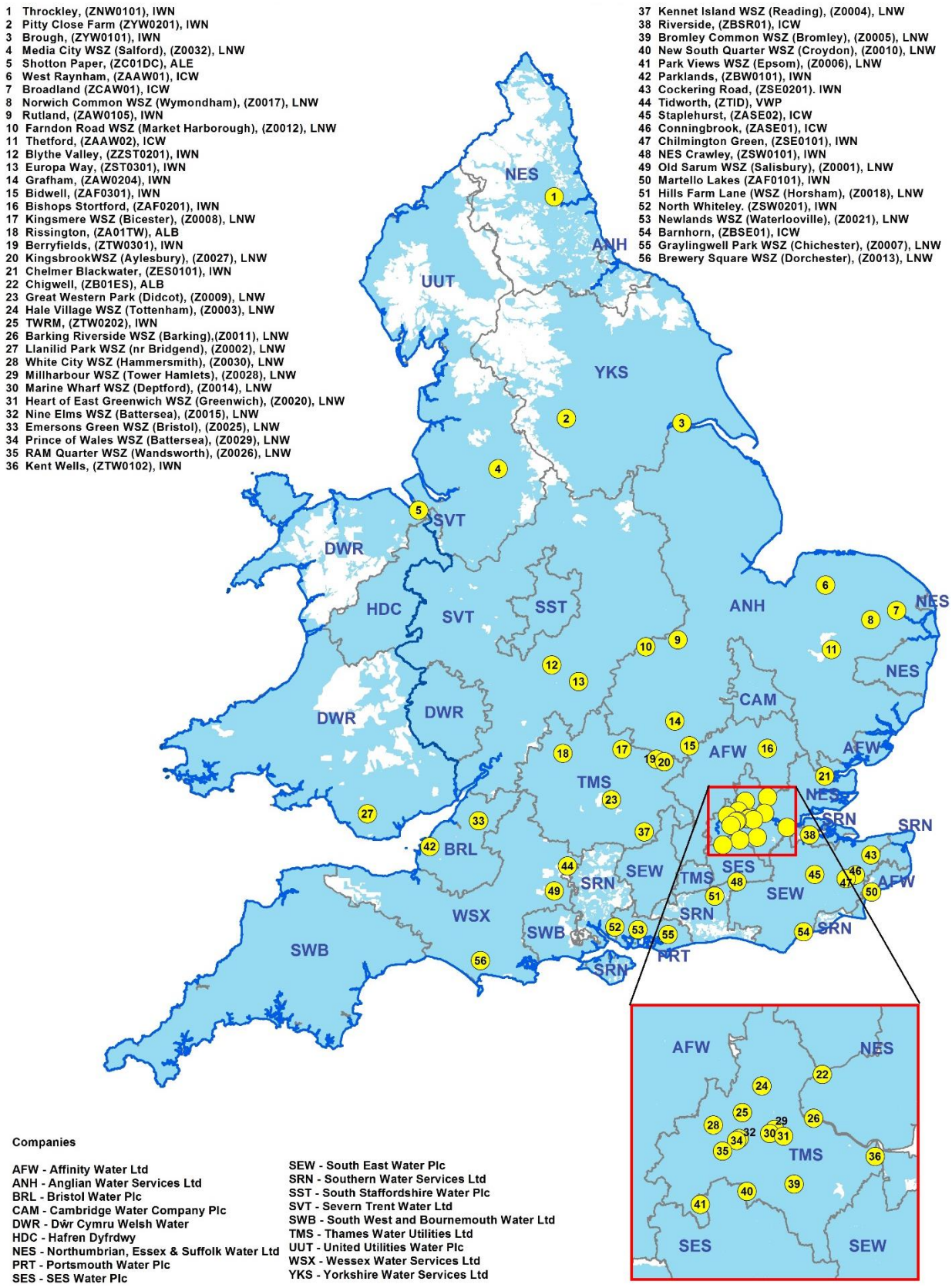


Figure 1: Water suppliers in England and Wales

Under WIA section 68 1991, the water supplier is under a statutory duty to supply wholesome water for domestic use or commercial food production purposes. This duty is enforceable by the Secretary of State, ultimately by Court order. For a water supplier, wholesomeness is defined in Regulation 4 of the Water Supply (Water Quality) Regulations 2016 (as amended) in England. These regulations, including the definition of wholesomeness, implement the European Drinking Water Directive for public water supplies. Under these regulations, the water supplier has a wide range of monitoring and other obligations which are also enforceable by the Secretary of State, ultimately by Court Order. Loss or damage caused by a failure of a water supplier to supply wholesome water for domestic purposes could result in a civil claim for damages by consumers. Supply by a water supplier of water unfit for human consumption is also a criminal offence under section 70 WIA. Additional offences cover design and operation of treatment works and requirements to disinfect water.

The Secretary of State's functions in relation to drinking water quality and sufficiency are performed by the Chief Inspector of Drinking Water and Inspectors appointed by Secretary of State under section 86 WIA. This includes being able to obtain relevant information on drinking water quality. It is a criminal offence under section 207 WIA for a water supplier knowingly or recklessly to supply false information under, or for the purposes of, the WIA. The Chief Inspector and statutory Inspectors have additional functions specific to their appointments which include the Chief Inspector being able to institute and carry out prosecution proceedings in the name of the Chief Inspector. In addition to this, penalty fines can be given by the DWI, on behalf of the Secretary of State, to water companies that do not comply with their duties in respect of drinking water quality under the WIA or the regulations.

The Water Industry (Suppliers Information) Direction 2019 requires water companies to notify the Inspectorate of any event which by its nature has affected or is likely to affect the quality or sufficiency of the water supplied by it. The Direction also requires companies to provide additional information at specified time periods in a format determined by the Inspectorate. The Inspectorate has issued guidance to water companies as to the reporting requirement of the Direction on its website at http://www.dwi.gov.uk and this is updated periodically.

2.3. Private Water Supplies

The WIA 1991 defines water supplies that are not provided by statutorily appointed water companies as private water supplies (PWS). PWS are highly variable in their circumstances, lay out and size. There are approximately 37,700 private water supplies in England, 68% of which serve a single household[1].

The risk of health effects from failures of water quality standards in single domestic PWS is not necessarily restricted to the immediate household or residents living at that address. A recent study in Cornwall found that 31% of single domestic PWS were not

[1] Drinking Water 2019 – Private Water Supplies in England http://dwi.gov.uk/about/annual-report/2019/PWS-2019-England.pdf

correctly identified and shared their supplies with other properties[2]. When enquiries are made regarding single domestic private supplies action should be taken to investigate if there are other properties also supplied from the source.

Most private water supplies are located in rural and remote areas. However, there are many more people, other than those served by a private supply that will have some contact with water from private water supplies as these can be used in the manufacture of certain foods and beverages, and serve various public buildings such as hospitals, village halls, hotels or, more often, campsites and leisure parks.

The quality of PWS is regulated by local authorities, who are responsible for enforcement of the Private Water Supplies Regulations 2016 (as amended). The drinking water standards which apply to private supplies are the same as those for public supplies as they are similarly derived from the Drinking Water Directive, but for the smallest public supplies much more emphasis is placed on risk assessment and risk mitigation rather than very occasional monitoring.

PWS are categorised in the relevant Private Water Supply regulations as described in the table below and this allows for proportionate and risk based monitoring.

Details of the sampling and monitoring requirements for England and Wales differ slightly and both have been included for comparison.

Table 1: Private Water Supplies are categorised in the relevant Private Water Supply regulations (2016), this allows for proportionate and risk based monitoring. Note the differences between the English and Welsh regulations.

	England	Wales
Regulation 8 supplies	Where water is supplied by a water undertaker or water supply licensee, and is then further distributed by a person other than a water undertaker or water supply licensee, the local authority must carry out monitoring on the basis of the risk assessment.	Where water is supplied by a water undertaker or a water supply licensee and is then further distributed by a person other than a water undertaker or a water supply licensee, the local authority must carry out any monitoring which the risk assessment shows to be necessary
Regulation 9 supplies	A supply covered by Regulation 9 is a private water supply (other than a supply specified in regulation 8) that : - supplies an average daily volume of water of 10m^3 or more, or	A supply covered by Regulation 9 is a private water supply (other than a supply specified in regulation 8) that : - supplies an average daily volume of water of 10m^3 or more; or

[2] Crabbe, H.; Close, R.; Rimmell, A.; Leonardi, G.; Watts, M.J.; Ander, E.L.; Hamilton, E.M.; Middleton, D.R.S.; Smedley, P.L.; Gregory, M.; et al. Estimating the population exposed to arsenic from groundwater-sourced private drinking water supplies in Cornwall, UK. In Best Practice Guide on the Control of Arsenic in Drinking Water; Bhattacharya, P., Polya, D.A., Jovanovic, D., Eds.; IWA Publishing: London, UK, 2017; Chapter A3; pp. 161–170. ISBN 139-7-81-84339385-6.

	- supplies water as part of a commercial or public activity. Where this applies, the local authority must monitor for parameters directed by the regulations and carry out any additional monitoring that the risk assessment shows to be necessary.	- supplies water as part of a commercial or public activity. Where this applies, the local authority must monitor for parameters directed by the regulations and carry out any additional monitoring that the risk assessment shows to be necessary.
Regulation 10 supplies	Where a private water supply is not covered by regulation 8 or 9 or is not a supply to a single dwelling which is not used for commercial or public activity, the local authority must monitor for 5 specified parameters and any other parameter designated in the regulations where the supply is identified as being at risk of not meeting concentrations or values specified. Anything else identified in the risk assessment as a potential danger to human health must additionally be sampled. This sampling must be done at least every 5 years and more frequently if the risk assessment shows this to be necessary.	This regulation applies to a private water supply to a single dwelling which is not used as part of a commercial or public activity (in which case regulation 9 applies) or as part of a domestic tenancy (in which case regulation 11 applies). Where this regulation applies, the local authority - may monitor the supply in accordance with the requirements in regulation 11(1); and - must do so if requested to do so by the owner or occupier of that dwelling.
Regulation 11 supplies		Where a private water supply is not covered by regulation 8 or 9 or is not a supply to a single dwelling which is not used for commercial or public activity, the local authority must monitor for 5 specified parameters and any other parameter designated in the regulations where the supply is identified as being at risk of not meeting concentrations or values specified. Anything else identified in the risk assessment as a potential danger to human health must additionally be sampled. This must be done at least every 5 years and more frequently if the risk assessment shows this to be necessary.
Single domestic dwellings	In the case of a private water supply to a single dwelling not provided as part of a commercial or public activity, a local authority may monitor the supply in accordance with the requirements for Regulation 10 supplies, and must do so if requested to do so by the owner or occupier of that dwelling.	

The role of DWI in respect of private supplies is to provide expert technical advice to local authorities, ensuring consistency of interpretation of drinking water legislation. The DWI are also responsible for collecting information from local authorities about PWS and reporting this annually alongside information about public water supplies. The regulations and DWI guidance is available on the DWI website[3]. For the majority of enquiries to PHE the most common involvement with drinking water is likely to be giving health protection advice to a local authority in respect of the quality of drinking water from a private water supply.

2.4. Public Health England

Public Health England is an executive agency of the Department of Health & Social Care (DHSC) created by the White Paper 'Healthy Lives, Healthy People: Our strategy for public health in England' released in November 2010. It took on the transfer of powers of the Health Protection Agency repealed by the Health & Social Care Act 2012.

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. We do this through world-class science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. We are an executive agency of the Department of Health, and are a distinct delivery organisation with operational autonomy to advise and support national and local government, local authorities, NHS, industry and the public in a evidence-based professional, scientific manner.

PHE is accountable to the Secretary of State for Health and Social Care and the Parliamentary under Secretary of State for Prevention, Public Health and Primary Care for delivering or supporting delivery of these responsibilities which are set out in an annual remit letter which is available on the PHE website at: https://www.gov.uk/government/publications/phe-priorities-in-health-and-social-care-2019-to-2020

PHE has several core responsibilities as outlined on the PHE website (https://www.gov.uk/government/organisations/public-health-england);

- making the public healthier and reducing differences between the health of different groups by promoting healthier lifestyles, advising government and supporting action by local government, the NHS and the public
- protecting the nation from public health hazards
- preparing for and responding to public health emergencies
- improving the health of the whole population by sharing our information and expertise, and identifying and preparing for future public health challenges
- supporting local authorities and the National Health Service to plan and provide health and social care services such as immunisation and screening programmes, and to develop the public health system and its specialist workforce

[3] www.dwi.gov.uk

- researching, collecting and analysing data to improve our understanding of public health challenges, and come up with answers to public health problems

PHE has an important role in reviewing and publishing the evidence and supporting scientific expert committees, to allow faster progress on improving the public's health.

PHE Centres are the front door for most of PHE's local services across health improvement, healthcare public health and health protection. Depending on their size and geography, Centres may have one or more local health protection teams who can assist with specific health protection enquiries. Each centre director is a partner in the local public health system. PHE have 8 local centres, plus an integrated region and centre for London, and 4 regional groups (north of England, south of England, Midlands and east of England, and London).
https://www.gov.uk/government/collections/contacts-public-health-england-regions-local-centres-and-emergency.

Similar arrangements exist for Scotland and Northern Ireland. In Northern Ireland, the health protection function is delivered by the regional Health Protection Service of the Public Health Agency and in Scotland by Health Protection.

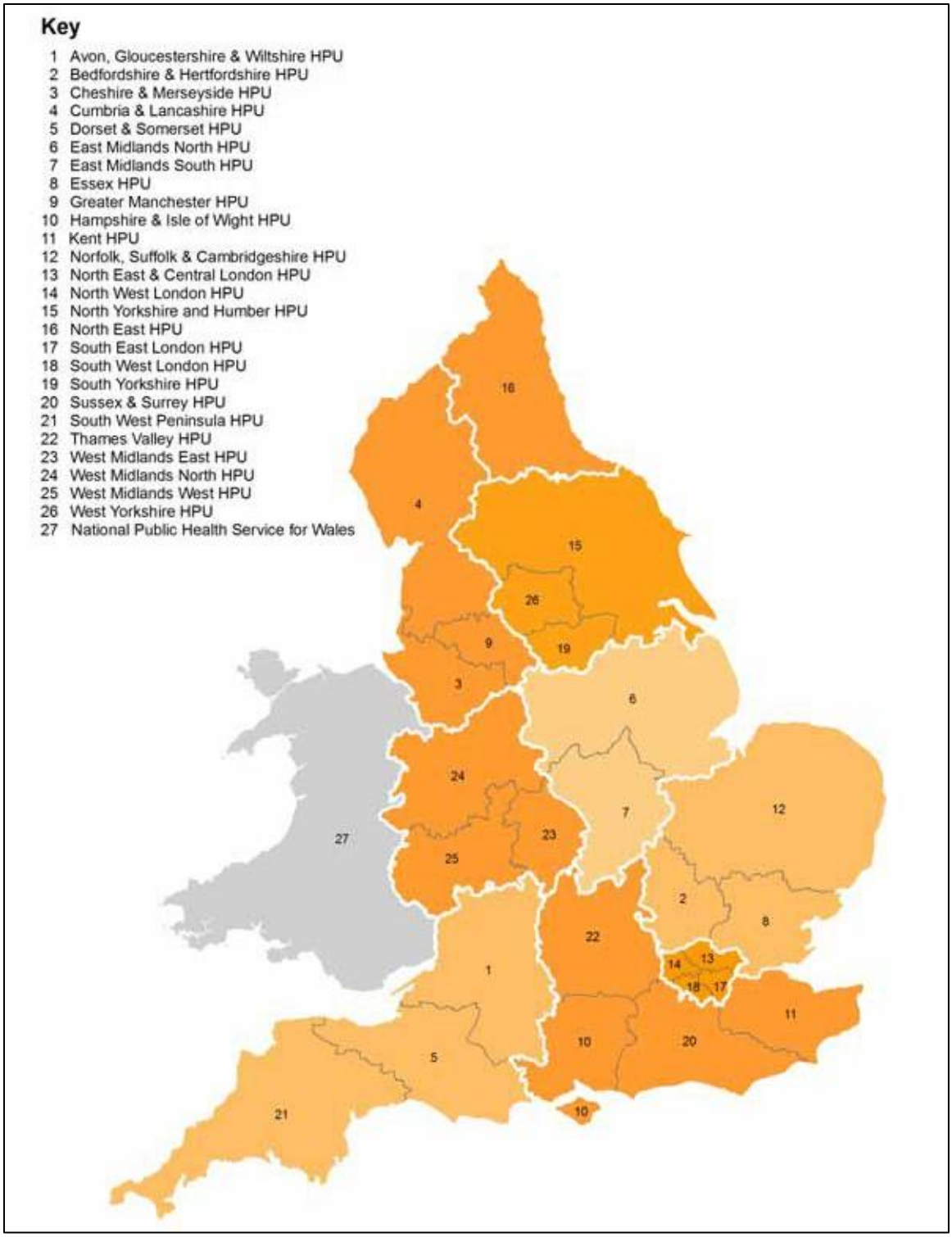


Figure 2: Boundaries for PHE Health Protection Teams

2.5. Local Authorities

2.5.1. The Water Industry Act 1991

For public water supplies this means that local authorities must have effective working arrangements in place with all water companies and licensees who supply water in their area. In particular, local authorities have a duty under section 77 of the Act to keep themselves informed about the wholesomeness and sufficiency of public water supplies in their area, and the Secretary of State has the power to direct local authorities on how to exercise their powers and duties, if deemed necessary. Local authorities also have powers to enforce water companies to provide alternative supplies when piped water supplies are unavailable.

Section 80 of the Water Industry Act 1991[4] places responsibility on local authorities for checking the safety and sufficiency of all water supplies in their area and subsequent sections powers to serve notice on relevant persons to rectify issues causing water quality problems. There is an appeal process for relevant persons for notices served under Section 80 of The Act, whereby the DWI Chief Inspector can be requested to review the notice and can either confirm the notice (with or without modifications), or not confirm the notice. This notice relates to issues of wholesomeness.

2.5.2. Regulations

Regulation 18 of the Private Water Supply Regulations allows for notices to be served by a local authority where water is a potential risk to human health, and in this case, the local authority must serve a notice. Any appeal by relevant persons in this situation must take the matter to a Magistrates' Court.

3. Wholesome Drinking Water

By law (the 1991 WIA), drinking water must be wholesome at the time of supply. Wholesomeness is defined by reference to drinking water quality standards and other requirements set out in the Water Supply (Water Quality) Regulations 2016 (as amended). Similarly for the Private Supply Regulations, regulation 4 also covers wholesomeness. These regulations are available on the DWI website (www.dwi.gov.uk). Many of the standards come from the 1998 European Drinking Water Directive which came into force fully on 25 December 2003 and subsequent amendments. The Directive focuses on those parameters of importance to human health, but it also includes others that relate to the control of water treatment processes and the aesthetic quality of drinking water. The Directive allows Member States to set additional or tighter national standards to secure the good quality of drinking water already achieved and to prevent it from deteriorating in the future. The Drinking Water Directive is currently under review. All requirements of the existing EU Drinking Water Directive are transposed into the Drinking Water Regulations for England and Wales and will be enforced by the DWI.

[4] https://www.legislation.gov.uk/ukpga/1991/56/contents

More information on the Directive standards is given in Annex 1 together with information about other substances that may be found in water and waterborne pathogens.

Where a breach of a drinking water quality standard has occurred that might have a potential impact on public health, water companies and local authorities are required to inform Public Health England and to agree, and undertake, the appropriate investigations and mitigation measures to control or prevent potential risk to health.

3.1. Drinking Water Testing

Water companies and local authorities have a duty to collect samples and test these for each of the substances and organisms (known as parameters) in the respective regulations. Over 3.5 million tests are carried out each year at consumers' taps, service reservoirs and treatment works supplied by water companies and over 180,000 tests on samples from private supplies are commissioned by local authorities across England and Wales. Companies must make the results of this testing available to their customers on request. Local authorities are required to provide sample results to the Inspectorate. The Inspectorate's role is to independently verify that this testing is being carried out to a high standard of quality control, for example laboratories are all accredited through the United Kingdom Accreditation Service (UKAS) to the standard recognised for drinking water (Drinking Water Testing Specification, DWTS). In respect of testing drinking water, the work of drinking water Inspectors is aimed at providing public reassurance that the robustness and integrity of analytical results is beyond question. DWI does not routinely test drinking water, although it has the power to commission independent tests if there is a compelling public interest and adequate justification.

Water companies are required to provide DWI with full details of their annual monitoring programme in advance and the results of these tests are subsequently transferred electronically to DWI on a monthly basis. DWI publishes a summary of the results of a water company's monitoring annually on its website.

Local authorities must also have in place robust arrangements for taking and analysing samples from private water supplies, as well as carrying out risk assessments by competent persons. They are able to charge the owners/uses of private water supplies for monitoring their supply. As local authorities do not have their own laboratories they will use an external accredited laboratory often a private company or water company and, to a lesser degree, may send samples to a public analyst or a specialist Public Health Food, Water and Environment laboratory.

Local authorities recover their costs for their regulatory activities, including risk assessments, investigations and monitoring. There is no legal requirement on local authorities to sample public water supplies, but samples may be collected when acting to resolve a water quality problem within a public building or in respect of social housing for example.

Organisers of temporary event such as the Glastonbury festival an agricultural show or carnival are required to ensure that the water they supply is safe to drink. It is their responsibility to make sure that fittings and fixtures meet regulatory requirements and ensure that the safety and security of the drinking water is maintained throughout the course of the event. For events supplied from the public supply, the Water Company is responsible for making sure the water at the point of connection is safe and wholesome and they also have the power to carry out inspections of the pipework within the site. If the organisers intend to use a private water supply, the local authority is responsible for carrying out a risk assessment and monitoring of the supply at the event. In all cases, the local authority will expect organisers to comply with British Standard BS8551:2015 Provision and management of temporary water supplies and distribution networks (not including provisions for statutory emergencies). The short term provision of water for a temporary event using tankers, bowsers, mobile or static tanks should not be regarded automatically as a regulation 8 situation. For all Regulation 8 supplies, the water company is still responsible for monitoring and enforcing the Water Supply (Water Fittings) Regulations 1999.

In the event of an infectious disease outbreak (e.g. SARS-CoV-2 (CoViD-19)) the requirements of the regulations continue to apply, including those relating to sampling and compliance, monitoring, reporting and any other operations intended to secure the abstraction, treatment, storage and delivery of wholesome water. Additionally, the requirements of the Information Direction relating to non-compliance with the Regulations continues to apply. In such an outbreak, customer facing staff, especially samplers who visit domestic premises, may experience an increased level of difficulty as fears, rational, or otherwise, may impede the normal daily work. A dynamic risk assessment should be made in such circumstances and it is expected that a sampler would make a reasonable number of attempts to obtain a sample. Reasoning for not taking a sample should always be documented. Any change in government advice relating to an infectious disease outbreak may be region specific and could include restricted areas which may make it difficult or impossible to enter domestic premises or areas. In such circumstances a Regulation 7 notice may be issued to water companies giving a variation on sampling. In all circumstances water companies must prioritise the operation of treatment works and continue to monitor critical control points such as point of disinfection and service reservoirs. Online telemetry should always remain in operation.

Laboratories should make contingency plans for continuing analytical services in circumstances where movement and staff availability are limited or restricted. Where there are impacts on analytical capability the Inspectorate will be notified. In all circumstances, microbiological analysis including *Cryptosporidium spp.* will be prioritised.

4. The Safety of Drinking Water

The regulations make specific provisions for drinking water safety and require water

companies and local authorities in respect to private supplies to implement a risk management (water safety plan) approach to water production and distribution as recommended by the World Health Organisation (2011 WHO Guidelines for Drinking Water Quality). The latest WHO guidance on water safety planning is available at; http://www.who.int/water_sanitation_health/water-quality/safety-planning/wsp-publications/en/.

Publications include:

- Water safety plan manual
- Climate – resilient water safety plans
- Principles and practices of drinking water chlorination
- Potable reuse
- Water safety planning for urban water utilities
- Protecting surface water for health
- A practical guide to auditing water safety plans
- Water safety plan – A field guide
- Water safety in distribution systems
- Water safety in buildings
- Water safety plans – managing drinking water quality for public health

4.1. Water Company Responsibility In Relation To Water Safety

Water companies are required to have adequate water treatment in place, informed by a regulatory, raw water monitoring programme. They must disinfect all water before supplying it and, where necessary, subject the water to sufficient preliminary treatment to prepare it for disinfection (regulation 26). As a minimum this must ensure that the turbidity of water is <1 NTU (Nephelometric Turbidity Units) prior to disinfection. The method of disinfection is not set out in law, but DWI require water companies to define and document their disinfection policy and implement it through written procedures for each treatment works.

For every treatment works and associated water supply system, water companies have to carry out and keep up-to-date a risk assessment to establish whether there is a significant risk of supplying water that would constitute '*a potential danger to human health or is likely to be unwholesome*'. Reports on these risk assessments are submitted to DWI and are subject to audit and enforcement action where necessary. *Potential danger to human health* is a term which derives from the Drinking Water Directive. In practice, in the UK, this term is understood better as a potential risk to public health generally. It is not a consideration of the medical needs of a particular individual. Likewise, the risk assessment is concerned with the human population. There is no requirement to assess the risk to pets, livestock or fish.

As well as covering microbiological, chemical and radiological hazards, regulatory risk assessments also cover other physical and organisational hazards which may result in a

failure of the water supply (no water) or consumers rejecting the water for aesthetic reasons i.e. not wholesome. Where an unacceptable risk is identified, water companies must put in place an urgent programme for mitigation and control, including, where necessary, short, medium and long-term improvement measures. DWI requires water companies to communicate effectively about their risk assessments with key stakeholders and this means that PHE and local authorities should be briefed on, and consulted about, specific risk assessments for water supplies in their areas. Through these consultations, Public Health Professionals have the opportunity to become familiar with the local water supply arrangements, to ask questions and satisfy themselves that it fully takes account of the public health needs of the local community. If they are not satisfied in this respect they should raise their concerns with the water company in question and the DWI. DWI has the power to issue notices directing a water company to take certain actions in respect of its risk assessments.

Other water safety requirements of the regulations include the fact that water companies must treat water to make it less aggressive towards lead and copper plumbing where this has been shown to be a problem with a specific water supply. There are also regulatory controls (regulation 31) over the chemicals and materials of construction that water companies are permitted to use. DWI operates a national approvals system for chemicals and materials of construction, and the published list of approved products is available on the DWI website. The Centre for Radiation, Chemical and Environmental Hazards (CRCE) of PHE provides toxicological advice to DWI in respect of decisions about the approval of materials.

Water suppliers that fail to adequately treat and/or disinfect their water supplies, or fail to take action in respect of their risk assessments, or who use unapproved chemicals or materials, may have committed a criminal offence. DWI Inspectors carry out independent technical audits of company records and sites to ensure that operational and management procedures are robust. If deficiencies are identified, DWI has the power to take enforcement action to require improvements to be made.

It is not uncommon for a drinking water quality problem to be due to the condition of building water systems rather than the distribution system owned and operated by the water company. Water companies have powers under the Water Supply (Water Fittings) Regulations 1999 to inspect premises to ensure the public water mains are protected by backflow devices or other means from any possibility of contamination from water used in industrial processes, wastewater or any private supply. Water companies have a programme of regular inspections of high risk building water systems in place and will carry out inspections in response to unexplained consumer complaints. They also have a programme to check any new connections to their distribution networks. It is not uncommon to find interconnections between private and public supplies that are not sufficiently protected by backflow prevention. Water companies should be aware of high risk locations in their area (farms, industrial units) and ensure that an appropriate inspection regime is in place. Local authorities should be vigilant and identify any risk of interconnections with mains water identified when carrying out risk assessments should be escalated and mitigating protection put in place.

Water companies adhere to stringent hygiene procedures to ensure that none of their employees or contractors is allowed to work in restricted water supply areas if they are suffering from an infectious disease that may be waterborne. Water Hygiene training courses are delivered through Energy and Utility Skills and a Water Hygiene (EUSR) Card is issued. The course emphasises awareness of individuals' responsibilities towards the potable water supply and verifies that the employee has demonstrated an appropriate level of knowledge and awareness with regards to hygiene and water quality issues.

5. Events and Incidents

5.1. Public Water Supplies

Section 70 of the WIA 1991 makes it a criminal offence for a water company to supply water that is unfit for human consumption. However, the WIA provides a defence for the water company if it can show that it had no reasonable grounds for suspecting that unfit water would be consumed, or it had taken all reasonable steps and exercised all due diligence to ensure that water was fit for human consumption on leaving its pipes. There is a regulatory duty on water companies to notify DWI of any event which has the potential to give rise to a significant risk to public health or otherwise cause consumers concern directly (appearance of water) or indirectly (adverse media comment). It is also regulatory duty for such events to be notified to local authorities, Public Health England and the Consumer Council for Water. Others, including consumers, journalists and whistle-blowers, can also make the DWI aware of any actual or potential event.

Inspectors will assess the significance of all notified events on a risk-based approach. Where necessary, they will investigate and take enforcement action which may include initiating proceedings or issuing a caution or notice. In addition to the offence of supplying water unfit for human consumption in the Act, it is also a criminal offence for a company to fail to comply with Regulation 26 (adequate treatment and disinfection of water) or Regulation 31 (use of only approved chemicals and materials).

When conducting their investigation, Inspectors will gather evidence in the form of technical and management information from the company and through interviews of relevant persons, including members of the public, contractors, consultants and advisors, potentially including local authority and PHE staff. Inspectors are trained in, and follow, Police and Criminal Evidence Act (PACE) procedures. DWI publishes its findings and recommendations in the form of an Event Assessment Letter (EAL) and copies of these are provided to PHE, the affected local authorities and the Consumer Council for Water.

A water quality event is defined as any biological, chemical or radiological occurrence which by its nature is required to be notified under the Water Supply (Water Quality) Regulations 2016 or the Private Water Supplies Regulations 2016. When an event has the potential to have a significant impact on public health, it can be escalated to an

incident and an Incident Management Team (IMT) formed. Examples of "significant" would include outbreaks of water-related illness or a sizeable population exposed to a chemicals of health significance where the contaminant is at levels above the prescribed concentration or value[5]. Box 1 includes examples of the criteria that may be used to trigger an IMT.

Box 1: Criteria for establishing an Incident Management Team (IMT)

- An **exceedence** of drinking water standards (e.g. a prescribed concentration or value (PCV)) and guidelines as set out in the Water Supply (Water Quality) Regulations 2016 or the Private Water Supplies Regulations 2016 that is unacceptable in terms of public health (termed a non-compliance event).
- Reports of an **unusual deterioration or changes** in water quality that may have an implication on public health. For example, analytical data suggesting increase metal or pesticide concentrations, changes in colour or turbidity that may indicate a change in the water treatment process.
- Reports of **failure or poor performance** of water treatment and disinfection activity (for example a near miss).
- Reports of **potential external contamination of** a water supply or water catchment area that could result in a future non-compliance event or near miss (for example diesel spillage threatening water supply).
- Reports of **site security issues** associated with water supply or treatment process.
- Any evidence of **unusual and unexplained clustering of cases** in the community related to a water supply.
- Any significant **perceived risk** to the health of consumers.
- Significant **consumer perception or concern** about the quality of the water supplied or changes in water quality.
- One or more core partners have already declared the event a public health incident.
- Any combination of the above

If the incident becomes an outbreak, an outbreak should be declared, the IMT dissolved and an Outbreak Control Team (OCT) formed. Both the need to establish an IMT and its membership will vary from case to case and will be determined by the Director of Public Health (DPH) in consultation with the Consultant in Health Protection

[5] Some chemicals have PCVs that are not health based and it is unlikely an IMT would be called for contaminants where the PCV is based on taste and odour.

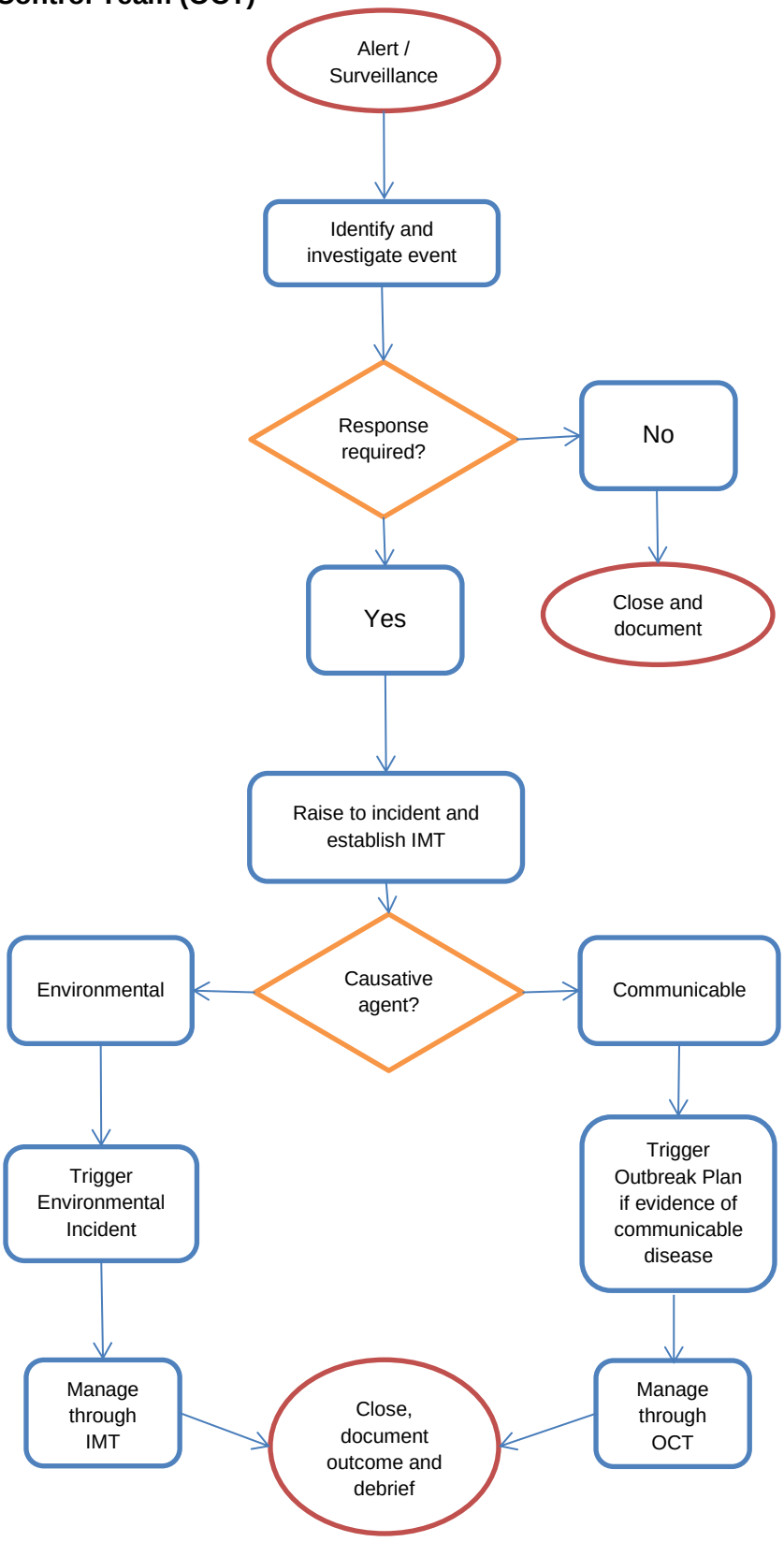
(CHP) / CCDC in Public Health England, the role of the OCT or science advisory group is provided in PHE guidance.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/781573/INIDC_guidance_v1.0.pdf

An outbreak is usually declared jointly by Consultant in Communicable Disease Control/ Consultant in Health Protection (CCDC/CHP) in conjunction with the Local Authority and the Health Board (including the Clinical Lead for Microbiology and the Director of Public Health). More details on the role of the OCT can be found in the PHE Communicable Disease Outbreak Management Operational Guidance document.

Guidance for investigating non-infectious disease clusters from potential environmental causes can be found at
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/781573/INIDC_guidance_v1.0.pdf

Figure 3 presents a flowchart summarising the IMT/ OCT decision.

Figure 3: Flowchart summarising the activation process for an Incident Management Team (IMT) or Outbreak Control Team (OCT)



The primary objective of the IMT or OCT is to protect public health by identifying the source of the contamination and implementing the necessary control measures to minimise or reduce exposure and prevent further spread, recurrence or exposure. Core members of the IMT/OCT include PHE, Local Authorities and Water Companies. Co-opted members can also include the EA, Food Standards Agency and the DWI. The IMT/OCT will usually be chaired by a DPH within the relevant authority and the Chair will be agreed at the first meeting. However, any member of the IMT can chair by the agreement of the members of the IMT.

The core actions of an IMT/OCT include:

- Undertake a risk assessment to identify the contaminant(s), the source and extent of contamination.

- Identify gaps and information needed to update the risk assessment.

- Evaluate and characterise the risk to public health and likely illness in the community, including defining the population at risk and identifying any high risk / susceptible individuals such as immuno-compromised groups, home dialysis patients, health-care settings.

- Declare an 'Outbreak' if there is evidence of communicable disease following the contamination incident.

- Agree and initiate immediate and long-term control measures to reduce exposure. Immediate control measures may have been taken by the water company before the IMT is formed and these should be reviewed by the IMT. Box 2 summarises some of these control measures.

- Communicate to the public and medical professionals including publication of media statements.

- Consider undertaking an epidemiological study to describe symptoms/cases.

- Monitor control measures by continued surveillance for disease/symptoms.

- Lift Warning Notices subject to agreed criteria being met.

- Evaluate the management of the incident and make appropriate recommendations for the future.

- Declare the incident over.

- Produce report on the outcome including recommendations and epidemiological report (if required).

Box 2: Examples of control measures in response to water quality event

Immediate:

- Stop water abstraction
- Flushing of supply system or individual supply pipes
- Issue warning advice/ notices:
    - Boil before Use for drinking and food preparation (BWA)
    - Do not use for Drinking or Cooking (DND)
    - Do not use for Drinking, Cooking or Washing (DNU)
- Providing alternative supplies, such as:
    - Bottled water (also see http://www.legislation.gov.uk/wsi/2015/1867/contents/made)
    - Bowsers and tankers
    - Diverting sources or Re-zoning (introduction of water from a different supply)

Long-term / permanent:

- Additional water treatment processes (process control)
    - Activated carbon
    - Water filters
    - Increased disinfection
    - Phosphate dosing
- Replacement of water pipes e.g. lead pipes
- Permanent provision of different supply (e.g. moving from private water supply to mains)

Public Health controls:

- Isolate or exclusion of cases and contacts
- Screening and monitoring of contacts
- Immunisation or prophylaxis
- Specific advice and interventions to highly susceptible groups e.g. protection measures for:
    - for immunosuppressed groups
    - recommend home dialysis patients receive treatment in hospital
    - lead exposure and children
    - bottled water and infants

The water company may also set up their own operational Incident Management Team (WCo-IMT) tasked with issuing any short-term health protection warning to consumers and carrying out the necessary work to restore the water supply to normal. This will link closely to the IMT/OCT and one or more members of the WCo-IMT will sit on the IMT/OCT and provide operational updates and report back to the Water Company any requests for information and advice.

While the vast majority of events will be managed through an OCT/IMT, there will be rare occasions where an event may necessitate the activation of civil contingency arrangements. This is likely to where the nature or scale of the event meets the definition of a major incident in the Civil Contingencies Act. A major incident is defined as “an event or situation, with a range of serious consequences, which requires special arrangements to be implemented by one or more emergency responder agencies.”

Scenarios where this may be necessary include a suspected chemical, biological, radiological, nuclear and explosive (CBRNe) event, a widespread communicable disease outbreak or chemical incident that creates the risk that essential services will be overwhelmed or an event that require the implementation of civil restrictions on health protection grounds. In such scenarios, a Category 1 responder such as the emergency services or Public Health can initiate formal command control structures to manage the incident. These may involve escalation to the relevant Local Resilience Forum and the establishment of a Tactical Coordinating Group (TCG or Silver Command) and/or Strategic Coordinating Group (SCG or Gold Command). The SCG sets the strategy within which lower levels of command will operate.

Typically, the police will chair the SCG but it can be any Category 1 responder. If required, the SCG can access scientific and technical support through the Scientific and Technical Advisory Cell (STAC) which is usually chaired by PHE. The membership of STAC will depend on the nature of the incident and the specific response requirements that arise locally. For most incidents scientific advice is best provided through existing channels and agencies who routinely attend the SCG. A STAC should only be activated when there is a collective expectation that it can add value to the incident response.

At national level, if the scale of the event warrants it, the Civil Contingencies Secretariat may institute national response plans including regular meetings of the Civil Contingencies Committee (CCC) and the establishment of a Scientific Advisory Group for Emergencies (SAGE). For water emergencies, DWI would normally be invited to be a member of SAGE. Good communication between the STAC and the SAGE will be essential.

One of the requirements of the investigation is to evaluate the event and prepare a written report on the health impacts and disseminate any lessons learnt. This may include results of any epidemiological studies. The timing of the evaluation can be flexible; OCT/IMT may find it helpful to have time to reflect on the event prior to carrying out the evaluation. At this stage, any urgent recommendations will need to be flagged up prior to the full report. It is very important that this report confines itself to the health study and does not include details about the water supply or its management, because these matters will be investigated and reported upon by DWI and details may form the basis of criminal proceedings. It should be noted that the DWI report on an event usually takes the form of an assessment letter (EAL) which will be sent to all the parties involved in the event and will describe the DWI's findings, actions and conclusions. If the event investigation leads to the initiation of proceedings in court, the EAL will be issued only when the case had been concluded. It is recommended that the Chair of the IMT establishes direct contact with DWI when the IMT is first formed, to establish effective communications. It was a recommendation of the Third Report of the Expert Group on *Cryptosporidium* in Water Supplies (the Bouchier Report) published in 1998, that any report by an IMT be submitted to the Chief Inspector so that DWI can issue guidance to the water industry in respect of any key learning points.

5.2. Private Water Supplies

Regulation 18 of the Private Water Supply Regulations 2016 (as amended) in England requires that if any private supply of water intended for human consumption constitutes a potential danger to human health, a local authority acting under these Regulations must serve a Notice on any relevant person. The Water Industry Act 1991 defines relevant persons in Section 80. A Notice may be served on one, several or all of the relevant persons, depending on the cause of the potential danger to health and the appropriate mitigation required. In addition, the local authority should take into account any local agreements, covenants or deeds which specify responsibilities for specific aspects of the supply or its management. Further guidance on this is available on DWI's website.

Regulation 6 requires a local authority to undertake a risk assessment at least every five years for each private water supply within their area with the exception of a supply to a single dwelling where the supply is not provided as part of a commercial of public activity. Local authorities must carry out a risk assessment of such single dwellings if requested by the owner or occupier of the dwelling. The purpose of the risk assessment is to establish whether there is a significant risk of supplying water that could constitute a potential danger to human health. Local authorities must also use the risk assessment process to establish whether there is a risk of non-compliance with any of the standards or indicator parameter values outlined in the Regulations. The risk assessment should also be used as part of the information to enable local authorities to consider whether it can exclude parameters from any monitoring requirements. A link to the relevant tool can be found from this link: http://www.dwi.gov.uk/private-water-supply/local-auth/risk-assessment.html

If information is not provided by a relevant person, the local authority can use its powers under Section 85(1) of the Water Industry Act 1991 to serve a Notice on any person requiring that person to provide information about premises on a supply.

6. Protecting the Public during an Event or Incident

6.1. Public Water Supplies

Due to the nature and complexity of operational activities involved in the supply of drinking water, water companies will take a number of actions to protect public health, such as the provision of advice to consumers, some examples of which are described below. On many occasions the company should, and will, notify PHE and local authority staff as part of this process. The purpose of this notification is to provide PHE and the local authority the opportunity to provide medical/public health advice to the company that is pertinent to the local community affected. However, the responsibility for issuing warning notices to consumers and providing alternative water supplies (rezoning, tankers, bowsers and bottles) rests, at all times, with the water company. An example of the notification template generated by DWI and circulated upon notification of an event

affecting the quality or sufficiency of drinking water is provided in Annex 2.

As a matter of routine day-to-day water supply operations, temporary precautionary advice is issued by water companies to householders via social media platforms and water company website area bulletin updates. Additional precautionary advice may be given in the form of letters, leaflets or warning notices to specific consumer premises. The public is familiar with, and is therefore responsive to, such advice coming from their water supply company. Water bills sent to customers provide a number to ring to report a problem with the water supply. Water company websites and social media channels, provide water quality advice and can be an effective route of contact for the public to their water supplier. Local authorities for private water supplies will also issue precautionary advice where necessary. Listed below are the typical situations where precautionary advice is issued, together with details of how this is done, who is involved and why.

Planned work on the water supply: advance notices are delivered to each building in the affected streets in addition to emails and text messages sent to registered consumers. The notice will give details of the work, particularly the timing of any shut down of the supply. For example, it may advise that water may be discoloured when the supply is restored and what to do if this does not clear on flushing the mains tap.

Unplanned disruption to the water supply: typically caused by a burst main. Company website and social medial channels will be updated with area bulletins and customers ringing their water company will be given advice, often through a recorded message set up for particular post codes. The water company will notify the local authority and PHE of any disruption which is likely to be protracted (i.e. difficult to repair) or attract adverse media comment (i.e. traffic congestion) or affect a large number of homes and businesses. Companies have direct arrangements for providing alternate supplies by tanker, bowser and bottles to priority customers such as hospitals and schools.

Adverse routine test result- single household: samples are taken at random from consumers' taps every day of the year from network water supply zones. Adverse results are notified straightaway by the laboratory to the water company. The company will assess the risk to the consumer and arrange to collect further samples. The water company may choose to give precautionary advice to the householder until the cause of any problem has been identified. This advice is given verbally in the first instance, it may be to flush the tap before drawing water, or to boil the water before use, or not to drink or use the water. In the latter, more serious cases, the water company will usually provide an alternative bottled water supply for drinking. The water company will notify and consult the local authority and PHE of the adverse result and the action being taken.

Consumer water quality complaint – single household: companies have risk assessment procedures in place to ensure that a water quality scientist is notified of any call from a customer attributing illness to the water supply, or reporting an objectionable taste, odour or discolouration. If the problem is not clearly linked to a known operational problem, advice will be given over the phone and arrangements will then be made to

collect samples and /or inspect the plumbing at the property. The water company will notify the local authority and PHE of any adverse results. Customers reporting illness will be advised to visit their local doctor/ registered general practitioner. If it is clear that the person has been diagnosed with a water-related illness (e.g. cryptosporidiosis) or notifiable disease (Health Protection Regulation, 2010) the regional PHE team will be notified straightaway.

Adverse sample result or issue identified as affecting several properties or streets: during the investigation of an adverse result or consumer complaint at a single household (see above), it may become evident to a water company that there is a risk of contamination of the wider water supply, typically as a result of an illegal cross connection or inadequate back flow arrangements or spillage of chemicals. In these situations the company will issue precautionary boil water or do not drink notices to several premises or streets as a precaution. Examples of these notices are given in Annex 3. The water company will provide alternate supplies in the same way as it does for an unplanned disruption (see above). When the situation is resolved, water companies will deliver a second notice to say that the water supply has been restored to normal. The water company website, social medial channels and direct consumer text messages and emails will also be used. The water company will notify and consult the local authority and PHE of the situation and the action being taken.

Adverse sample result or some other type of problem affecting a water treatment works or a service reservoir/water tower: the water company will establish an Incident Management Team for any event involving an actual or potential risk to the water supply from a strategic water asset. All relevant local authorities and PHE will be notified and consulted by the water company and advised of the immediate actions being taken. The company will make arrangements at this time for a meeting (or conference call) with regional PHE groups and local authorities to discuss the risk assessment and the need for the public to be issued with precautionary advice and alternative water supply arrangements.

In a large scale event, the hazards posed by issuing a wide-scale warning notice need to be balanced carefully against the nature of the water supply event. Experience has shown that it is often preferable to implement enhanced health surveillance of the affected community instead of issuing a warning notice. Each situation has to be judged on its merits, taking into account local knowledge and whether or not water supplies can be returned to normal quickly or an alternate piped supply provided (by rezoning). If a decision is taken to issue boil water or do not drink advice, the basis for lifting the advice must be agreed at the same time. Experience has shown that significant problems can arise if the criteria for lifting the notice have not been decided when advice is first issued, although the criteria may need to be refined if new information becomes available.

The responsibility for issuing warning notices and providing alternative water supplies (rezoning, tankers, bowsers and bottles) rests at all times with the water company.

Local authorities have a responsibility for decisions about the continued operation of premises manufacturing or serving food and drink, and for public buildings such as schools and leisure centres. The regional PHE group and local authority is responsible for initiating contingency arrangements for hospitals and other health services. All responding agencies should ensure that only a common agreed form of public advice in the form of, for example, Frequently Asked Questions (FAQ) is provided to their staff in call centres or placed on websites. FAQs should be regularly reviewed such that they are in line with PHE, and DWI current guidance. There is also public health advice available on many other websites such as the PHE webpages and some reference laboratories. These links are included in Annex 1. Annex 4 also provides advice on precautions to be taken by the immunosuppressed individual in relation to boil water notices

6.2. Private Water Supplies

Where water from a private water supply in unwholesome, Section 80 of the Water Industry Act 1991 provides powers for local authorities to serve notice on all relevant persons on a private water supply, specifying the actions needed to correct the issue. Notices should have clear timescales and example template for local authorities are provided on DWI's website. Where the relevant persons do not take the actions required, the local authority may arrange for the work to be done and recharge the appropriate relevant persons.

In many cases the actions to be taken by the relevant person in relation to an issue on a private water supply will be very similar to those given above for public water supplies albeit on a smaller scale. However the relevant persons or the consumers may like to obtain advice from the local authority, PHE, their local water company or the Inspectorate in the case where they do not have the skills to solve the issues identified themselves. In protecting consumers on private water supplies, local authorities have the powers to issue notices restricting the use of water (Boil Water notice, Do Not Drink notice, Do Not Use notice). These notices should be served on all relevant persons on the supply. **When serving such a notice it is not acceptable to have no end point for the restriction. Local authorities need to specify a time limit, what needs to be done to rectify the problem and have included criteria for lifting the restriction.**

A case study on the inappropriate use of a private supply by a food business is given in the Chief Inspector's report on Private supplies in 2015[6]. In this example the food business had a private borehole and a connection to the mains water supply however following a water fittings inspection by the water company the food business was unable to make use of the mains supply as contraventions were found and therefore drew down on the borehole such that the quality deteriorated. Had there been better collaboration between the parties involved, the substantive economic, reputational and regulatory costs may have been avoided.

[6] Drinking Water 2015 – Private Water Supplies in Wales – Case study 6 pp 31-35. http://www.dwi.gov.uk/about/annual-report/2015/pws-wales.pdf

Another case example from 2015[7] involved an outbreak of *Escherichia coli* O157 (*E. coli* 0157) which occurred due to cattle accessing a spring source used as a private water supply to holiday lets. The underlying route causes were a change of use of the land from grazing sheep to grazing cattle, that cattle were able to reach the borehole headworks and defecate on it and that the original UV treatment system was undersized for subsequent increases in volumes of water needed to supply additional holiday homes put onto the supply. The outbreak highlighted the challenge of managing and investigating a situation where cases and contacts were spread widely. Overall 21 cases were identified ranging from a 2 year old to a 79 year old. What greatly aided the response to this outbreak was the promptness at which colleagues from other Health Protection Teams informed the PHE Cumbria and Lancashire team of their cases which could be potentially linked to the holiday let, and on the 13 August 2015 a "prohibition of use" notice was served on the water supply.

A number of learning points were identified from this case:

- The Internal Communications Summary highlighted the potential outbreak to other regional PHE teams and to NHS Scotland. This greatly speeded up the ability to link cases and confirm the outbreak.
- There is a need to respond promptly if a health professional thinks they have a linked case.
- An OCT allows for all responsible parties to manage the source and outbreak effectively.
- Health and water professionals need to be aware that the standard test for *E.coli* as a faecal indicator in PWS samples does not detect *E. coli* O157 per se, but is instead designed to identify faecal contamination; a positive sample should highlight the need for more detailed sampling that can speciate the bacterium.

Resources to aid the public health advice of the water quality of are outlined in Annex 1.

The chemical quality of private supplies can be driven by the quality of groundwater, from where the private supply is sourced. Many factors influence quality of groundwater, such as past industrial activity, soil contamination, seasonality, drought and precipitation rates. In some regions of England and Wales, private supplies are directly influenced by local geology or soil quality. From the 2011-2013 Cornwall study of single domestic PWS by PHE, it was found that up to 35% of supplies had exceedances of one or more prescribed concentration or value (PCV) of a range of chemicals and that 20% of households had one or more exceedance of health-based values for drinking water[8].

[7] Drinking Water 2015 – Private Water Supplies in England – Case study 7 pp 39-46. http://www.dwi.gov.uk/about/annual-report/2015/pws-wales.pdf

[8] Crabbe, H. Fletcher, T, Close, R. Watts, M.J., Ander, E.L., Smedley, P.L, Verlander, N.Q., Gregory, M., Middleton, D. R. S., Polya, D, Studden. M, and Leonardi, G.S. (2017) Hazard Ranking Method for Populations Exposed to Arsenic in Private Water Supplies: Relation to Bedrock Geology. Int. J. Environ. Res. Public Health 2017, 14, 1490;

The risk of arsenic contamination was associated with the type of local bedrock geology. Bedrock geology influences soil quality and both have been shown to influence groundwater quality. The British Geological Survey normal background soil contamination maps[9] show where there are high levels of arsenic, cadmium, copper, nickel and lead in soil. These maps can be used to give some idea of the areas where soil quality and bedrock may influence chemical quality of local ground water sources. This gives an indication for the risk of chemical contamination of single domestic private supplies and the need for risk assessments, water testing and monitoring.

Local authorities are best placed to advise on the intervention and treatment options of addressing microbiological and chemical quality of private supplies however they may need support from PHE and the local water company to understand the consequences of the identified risk. Information that might assist local authorities faced with a water quality problem is provided on the DWI's website in the *Manual on Treatment for Small Water Supply Systems*[10]

Safety of private supplies does not rely solely on testing. Risk assessment from source to tap combined with verification by testing should constitute the minimum activities. The risk assessment will then identify and need to sample beyond the levels laid down in regulations and there is freedom for local authorities to expand sampling in response to risk assessments.

7. Precautionary Advice and Key Event Learning Points

Two aspects of issuing warning advice to the public have proved problematic on more than one occasion in the past: the nature/type of the warning given and the provision of alternate supplies. The advice which follows draws not only on problematic events, but also those that were well managed.

7.1. Types of Precautionary Advice

When deciding on the advice to be given there is a choice to be made between one of three types of warning message:

- Boil before Use for drinking and food preparation (BWA – Boil Water Advice).
- Do not use for Drinking or Cooking (DND- Do Not Drink).
- Do not use for Drinking, Cooking or Washing (DNU- Do Not Use).

doi:10.3390/ijerph14121490http://dx.doi.org/10.3390/ijerph14121490

9 http://mapapps2.bgs.ac.uk/bccs/home.html

10 http://www.dwi.gov.uk/private-water-supply/installations/updated-manual-on-treatment-for-small-supplies.pdf

Whereas a BWA notice causes inconvenience in the home and can be disruptive to certain businesses (food and drink retailers and manufacturers) and public buildings (health care premises), the water industry has substantive experience of the practical aspects which are manageable and the public is familiar with the concept. Consumers should be advised that they should only use ice made from boiled water and should discard any ice previously made.

By contrast, a DND notice poses a more significant challenge to a water supplier due to the need to make 100 per cent provision of alternative water supplies for drinking and cooking. These logistical problems are magnified and further compounded in the case of a DNU notice because of the hygiene issues implicit in restricting the public's access to piped water for bathing, washing and toilet flushing. In some cases it may still be possible to use the water for flushing the toilet but the water supplier involved should make this clear to their consumers. Furthermore, the public is unfamiliar with water restrictions of this nature and on a large scale, and a far wider range of businesses will be affected. It is recommended that DNU notices are reserved for use only in those circumstances where there is unequivocal evidence of persistent contamination of the water supply with a substance (or radioactivity) at a level where short-term exposure is known to give rise to adverse health effects in the otherwise healthy population, and measures to restore the water supply to normal are likely to be protracted (weeks, rather than hours or days). Generally, the type of circumstances when a DNU notice might be considered are those where there is a major chemical pollution event which cannot be contained by the water supplier through stopping abstraction at the treatment works and/or the contamination has entered the treated water distribution system and the extent of the contaminated water cannot quickly be identified and contained/removed.

Another relevant scenario would be where the contaminant cannot be detected by a change in appearance, taste or smell of water (meaning consumers would not be alerted to the problem and thus unlikely to take avoiding action without being warned).

In most water quality events, therefore, the decision about which warning notice to issue is a choice between a BWA and a DND. Where there has been a loss of supplies due to a failure of an asset, the water supplier will be able to access records of water fittings inspections and identify whether there are any premises in the affected area classified as high risk in terms of potential to cause water contamination due to back flow or back siphonage. All high risk premises are routinely inspected and checked to ensure adequate back flow protection is in place. Furthermore, a back flow event is limited in scale impacting only on adjacent premises and streets in the immediate vicinity of the back flow site. Accordingly, a BWA notice (not a DWD notice) is the most appropriate one to use in 'loss of supply' events. As with DNU notices, the use of a DND notice should be reserved for those situations to safeguard against exposure to chemicals at a level where short-term exposure is assessed as being likely to give rise to adverse health effects.

The above guidance relates to the general public and in any event it is always important to separately consider the need to issue specific and different advice for vulnerable or

sensitive users (e.g. pregnant women, babies and immunosuppressed individuals). This should always be done through pre-arranged communication routes and professional networks, e.g. by local authorities for food manufacturers/retailers, through GPs or other established medical networks. Water suppliers have standing arrangements in place for notifying dialysis patients and for alternative supply arrangements for hospitals. PHE and local authorities will want to have standing arrangements in place for communicating with other vulnerable groups and other types of health and social care premises. For example, in the event of an infectious disease outbreak (e.g. SARS-CoV-2 (CoViD-19)) local authorities and GPs hold lists for vulnerable consumers who would be shielding and unable to attend bottled water stations. In such circumstances all vulnerable persons should be encouraged to separately register with the water company as requiring bottled water delivery and additional service where required. Current advice for the immunosuppressed in relation to *Cryptosporidium* is contained in Annex 4.

In support of reaching a decision about the most appropriate warning message, the water industry has access to a number of dedicated resources; the UKWIR (UK Water Industry Research) Toxicological Datasheets and Microbiology Datasheets[11] and the Call off Contract. The UKWIR Toxicological Datasheets and Microbiology Datasheets are jointly funded by the water industry and DWI and provide information to assist water suppliers to respond in a rapid and effective manner to a water contamination incident. It should be noted that only UKWIR members have access to these datasheets. In an event, the water company will be able to provide content from the UKWIR database to the PHE group or local authority where necessary. The UKWIR datasheets are updated every 5 years to ensure that they contain the most relevant information. The datasheets provide the user with; occurrence and likely sources of the contaminant, information on legislation and standards associated with the parameter, human health and mammalian toxicity data, health based and operational Suggested No Adverse Response Levels (SNARL) values for use in short term exposure situations, taste and odour data including thresholds and descriptors, information and advice concerning substance removal by water and wastewater treatment processes and information on analytical methods and detection limits. The derivation of SNARL values provides the suggested concentration of a contaminant in water that is considered to represent no significant risk to human health over a short period. SNARLS values are generally given for 24 hours or 7 days exposure only and include levels for adults, child and infant intakes. SNARLS are calculated using toxicological data or other derived values (such as the WHO Tolerable Daily Intakes) and include the reasoning behind any uncertainty factors applied. The assumptions used to derive SNARLs are a 60 kg adult drinking 2 L (of water)/ day, a 10 kg child drinking 1 L/ day and a 5 kg bottle-fed infant drinking 0.75 L/day. It is important to note that SNARL values do not constitute standards and are suggested values only to provide guidance to public health professionals.

The Call off Contract is an arrangement put in place and managed by DWI, whereby in an emergency or a security event a water company can access timely, sophisticated analysis for chemicals, toxins and organisms outside the range of routine capability of

[11] Data Sheets by UKWIR require a log on password that can be provided by UKWIR https://ukwir.org/eng/online-tools

water testing laboratories. Specialists in PHE, PHW and wider government are involved with DWI in the ongoing development of the facilities and resources inherent in the Call off Contract.

The water industry has arrangements in place to enable the rapid analysis of a range of contaminants that may result from the deliberate contamination of water supplies however the contractual arrangements of the Call off Contract are overseen by DWI and analysis can only be initiated by a DWI Inspector at the request of a named contact within a water company. The Inspectorate funds research into rapid analytical methods to support this contract.

7.2. Dissemination of Precautionary Advice

Consumers expect to receive and obtain information about their water supply from their water supplier or the relevant person in respect of a private supply. Every household and business or public premise receives details of how to contact their water supplier with their water bill. However, people who live in private rented or social housing may pay their water bill through the landlord, leaseholder or general rates and may not receive a bill directly. It is important, therefore, for local authorities to have plans in place to assist the water company by making social housing managers, landlords and leaseholders aware of any warning advice and generally take steps to facilitate its dissemination to residents and to publicise the water company telephone and website contact details.

The water company or local authority in the case of a private supply, is best placed to identify the area affected by any water supply event. This will be done using a variety of tools, e.g. GIS systems, customer and postcode databases. Some companies now publish the affected area on their websites during an event. As a general principle, at the outset of any event, the water company will err on the side of caution and overestimate the size of the affected area. This is because water supply arrangements can be complex, for example, there can be more than one pipe and supply serving a single street. Also, the water company is often able to quickly rezone an area of supply providing alternative safe supplies by means of pipes. Most water companies will place a description of the affected area by postcode on their website and all water companies will set up a recorded telephone message service which recognises the postcode of the caller and advertises the event information to callers. PHE and local authorities should make sure that warning communications issued by them for vulnerable or sensitive groups of water users direct people to appropriate information about the affected area. It is very important to understand that this information is likely to change during the course of an event. In an event affecting public supplies, it is not recommended that CHPs or local authorities prepare their own or separate notices or descriptions of affected areas. Public facing health services and organisations such as NHS 111 should also be advised to direct people to the water company as the single definitive source of information.

Whereas the water company will deal with issuing advice to the general public and will

also handle calls from consumers seeking clarification of the affected area or additional information, it is the role of PHE to make contact information available to the water company to facilitate the referral of anyone who is reporting illness symptoms. This will be a non-public CHP number or email for water company use only or other professionals. It is also the role of the CHP to assist the water company in modifying its standard pre- prepared Frequently Asked Questions (FAQ) and Answers to take account of unique or specific features of the event. The jointly agreed FAQ will be provided to water company call centre staff and can be issued to other organisations that may be called by the public, e.g. local authorities, NHS 111. Every effort should be made to ensure that a common script is used by all organisations in their call centres and on their websites. The CHP should also be contacted in relation to consumer advice for Private Water Supplies

8. Provision of Alternate Supplies

When there is an extended loss of water supplies or a DND/DNU notice is issued, water companies will provide alternate supplies by several methods depending on the nature and scale of the event:

- Bottled water.
- Static tanks, collapsible boxes with liners or mobile tanks (known as bowsers) and tankers.
- Rezoning (introduction of water from a different source into the piped network).

When bottled water is supplied by a water company in place of a piped supply they must comply with the Water Supply (Water Quality) Regulations 2016 (as amended). Some commercially available bottled waters may not be suitable for making up feeds for infants due to their mineral (salt) content and all bottled water, like tap water, must be boiled and then cooled prior to use for infant feeds. Water companies have standing arrangements in place for the provision of alternate supplies by means of bottles or containers and compliance with the relevant regulations will be covered by documented procedures and within the contractual arrangements with third parties.

The water industry has mutual aid arrangements in place for the mobilisation of tankers and static tanks. Static and mobile tanks and tankers will be clearly marked with a permanent notice at the draw off point to warn users that the water must be boiled before use. While such water supplies will be from a safe source and water companies have strict hygiene arrangements in place for the tanks and tankers themselves, there is no control over the hygienic status of the containers used by the public for collecting water from the draw off point or for storing it within the home. The standing boil water advice therefore safeguards against these hygiene risks.

When static and mobile tanks are deployed they will be refilled by the water company using tankers on a regular basis and their locations publicised. The tanks are designed

to be as vandal-proof as possible, however it is not unknown for the public to attempt to damage or remove these tanks. Local authorities have a role to play in the selection of sites and promotion of monitoring of the security of static tanks by, for example, local community groups, neighbourhood watch schemes etc.

The Security and Emergencies Direction issued by the Department for Environment, Food, and Rural Affairs (Defra) indicates that water company plans should aim to commence the distribution of water by alternative means as soon as possible after the failure has occurred. The amount to be provided should be at least ten litres of water per person per day to all those affected within the first 24 hours of an undertaker becoming aware of an event and this supply should be maintained until the piped supply is restored.

While water suppliers must plan for a minimum of ten litres per person per day in accordance with the notification, there may be emergencies where logistical problems prevent this being achieved in the first 24 hours. It is also recognised that for a major event, the ten litre requirement may not be achievable until the numbers affected are reduced to a level within the Local Response Plan.

If the event is more protracted and piped water is not available for drinking, cooking or washing, the target amount of water to be supplied will be increased. Defra has issued guidance on this additional planning target in 2017. In these protracted circumstances, additional advice will need to be provided to the public regarding sanitation. PHE will lead in the provision of this advice to the public.

In the case of private supplies, the Drinking Water Inspectorate has issued guidance on managing insufficiency of private water supplies[12] which recommends the following;

- Local authorities identify, along with water companies, local options for the provision of alternative water supplies in emergency situations;
- That relevant persons on a supply have a robust documented contingency plan for temporary disruptions (planned maintenance etc.);

The guidance goes on to provide options for provision of and emergency supply.

9. Public Information about Drinking Water Quality

Up until the 2007 Amendment Regulations there was a regulatory requirement on water suppliers to supply all local authorities within their area with an annual report on drinking water quality in a specified format. This is no longer the case, because DWI publishes annual summaries of water company results with a commentary about the significance of the information for the benefit of consumers, businesses, local authorities, health professionals and other regulators. The latest drinking water quality test results for each

[12] http://www.dwi.gov.uk/stakeholders/guidance-and-codes-of-practice/pws-alt-supplies.pdf

water company are summarised on the DWI website[13]. Water companies are still required by the regulations to provide information on drinking water quality on request to any person. This has to be free of charge for information on the zone in which the person resides, but a charge can be made for information on wider areas of supply.

Water companies and CHPs should maintain good liaison and there should be at least an annual meeting of the water companies, local authorities and CHPs to exchange information. CHPs are also welcome to contact DWI at any time for any information on drinking water quality.

Other sources of water quality information include the company's own websites, Ofwat pages and the Discover Water site[14], which compares water company performance on all matters including water quality.

9.1. Consumer Complaints

If a consumer believes there is something wrong with the drinking water in their home or workplace they should contact their water company or, in the case of a private supply, their local authority environmental health department. Water companies can arrange for tests to be done or check that plumbing arrangements are correct and comply with the Water Supply (Water Fittings) Regulations 1999. Companies will advise consumers of the action to be taken or, if required, will take enforcement action to secure improvements in plumbing. If the consumer considers that the water company did not deal with their drinking water quality concerns appropriately they can ask DWI to look into the matter on their behalf.

If the complaint is about another aspect of the water service, such as water charges or pressure, consumers should take the matter up with the regional branch of the Consumer Council for Water[15].

If the water quality concern is about the quality of a water course or water body, the query should be directed to the Environment Agency. The Environment Agency deals with the protection of the environment and regulates water abstraction and discharges to the water environment.

10. Other UK Drinking Water Regulators

There are equivalent organisations to the Drinking Water Inspectorate in Scotland (the Drinking Water Quality Regulator) and Northern Ireland (the Drinking Water Inspectorate for Northern Ireland). Each has their own regulations and legal responsibilities, but these are almost identical to those applying in England and Wales. The main difference is that

[13] http://www.dwi.gov.uk/about/annual-report/index.htm

[14] www.discoverwater.co.uk

[15] The Consumer Council for Water (CCWater) represents water and sewerage consumers in England and Wales. Their website at http://www.ccwater.org.uk holds more information on their role

there are only single, state owned water suppliers in Scotland and Northern Ireland.

11. Control of New and Emerging Issues: Approach and Rationale

In addition to meeting the numerical standards specified in the regulations, to be considered 'wholesome', drinking water must not contain any micro-organism or substance at a concentration which would (on its own or in combination with another micro-organism or substance) constitute a potential danger to human health.

Where micro-organisms or substances not specified in the regulations are identified, their potential danger to human health is assessed on a case-by-case basis. This will involve water companies discussing their findings with CHPs and local health authorities to determine the significance for the local community, in particular are there are specific groups of individuals who may be more susceptible to the potential effects? Where the presence of certain substances may be potentially more widespread, or where an emerging issue is considered more significant, DWI may issue national guidance to the water industry. This guidance is based on national advice from PHE Centre for Radiation, Chemical and Environmental Hazards (CRCE). It is circulated to all water suppliers, and published on DWI's website (see http://www.dwi.gov.uk).

12. Drinking Water Quality and Health Research Programme

On behalf of the Government, (Defra) DWI manages the national Drinking Water Quality and Health (DWQH) Research Programme. The research supports Defra and Welsh Government policy on the quality and regulation of water supplies and enables the UK to contribute to the international evidence base for drinking water quality regulations and standards.

Electronic copies of the final reports of all Drinking Water Quality and Health (DWQH) research projects are available on DWI's website[16].

Executive summaries are also posted on the Foundation for Water Research (FWR) website[17] which also provides links to other research programmes.

DWI and PHE/ PHW have arrangements between them such that PHE/ PHW act as national advisors on the health aspects of drinking water. Continual dialogue exists between PHE/ PHW and DWI staff responsible for scientific evidence on current and emerging issues. Additionally, the DWQH research programme manager co-ordinates formal horizon scanning meetings to identify emerging issues for inclusion in the programme. These discussions involve representatives from across government, other UK drinking water regulators and organisations, such as UKWIR, PHE, PHW, EA, NRW, independent experts, and others.

[16] www.dwi.gov.uk
[17] www.fwr.org

13. References to Regulation

Water Industry Act 1991
https://www.legislation.gov.uk/ukpga/1991/56/contents

Water Act
2014: https://www.legislation.gov.uk/ukpga/2014/21/pdfs/ukpga_20140021_en.pdf
2003: http://dwi.gov.uk/stakeholders/legislation/wa2003.pdf

Water Supply (Water Quality) Regulations 2016 (as amended) in England
https://www.legislation.gov.uk/uksi/2016/614/contents/made

Water Supply (Water Quality) Regulations 2018 in Wales
https://www.legislation.gov.uk/wsi/2018/647/contents/made

The Private Water Supplies Regulations 2016 (as amended)
https://www.legislation.gov.uk/uksi/2016/618/contents/made

The Private Water Supplies Regulations 2017 (Wales)
https://www.legislation.gov.uk/wsi/2017/1041/contents/made

The Water Supply (Water Fittings) Regulations 1999
http://dwi.gov.uk/stakeholders/legislation/ws(fittings)regs1999.pdf

Annex 1: Drinking Water Hazards

The drinking water quality standards are set out in statute in the Water Supply (Water Quality) Regulations 2016 (as amended) which apply in England and the Water Supply (Water Quality) Regulations 2018 which apply in Wales. The same, or very similar, standards are set out in equivalent regulations in Northern Ireland and Scotland. Most of the standards are those set out in the European Drinking Water Directive and are derived mainly from the recommendations of the World Health Organisation (WHO). There are also some national standards. Each regulated substance or organism is known as a parameter. As well as setting standards for each parameter, the regulations state how often each one should be tested for and where the samples for testing should be taken. About one-third of samples are taken from consumers' taps and the rest are taken from treatment works or treated water storage reservoirs. The parameters and standards are described below. Anyone wishing to find out more about how each standard is derived can do so by accessing the published WHO expert opinion[18]. When the regulations are revised there is full public consultation by Defra.

Microbiological Standards

To protect public health there are microbiological standards which must be met at each treatment works and treated water service reservoir or water tower.
Microbiological tests are also undertaken on consumer tap samples. The significance of individual test results for each microbiological parameter at each location varies and a single positive result does not necessarily mean that water is unsafe to drink. Other information is required to assess water safety. Each of the standards is listed below:

Escherichia coli **and Enterococci** are bacteria present in the gut of warm-blooded animals. They should not be present in drinking water and, if found, immediate action is required to identify and remove any source of faecal contamination that is found.
The standard is 0 per 100ml.

Clostridium perfringens is a spore-forming bacterium that is present in the gut of warm-blooded animals. The spores can survive disinfection. The presence of spores in drinking water in the absence of *E.coli* and Enterococci indicates historic or remote faecal contamination that requires investigation. The standard is 0 per 100ml.

Coliform bacteria are widely distributed in the environment often as a result of human or animal activity, but some grow on plant matter. Their presence in a water supply indicates a need to investigate the integrity of the water supply system. The standard is 0 per 100ml.

Colony Counts are general techniques for detecting a wide range of bacteria, the types and numbers being dependent on the conditions of the test. These counts, if done

[18] http://www.who.int/water_sanitation_health/water-quality/guidelines/drinking-water-guidelines-revision/en/

regularly, can help to inform water management, but they have no direct health significance. The standard is ‘no abnormal change’.

Health Based Chemical Standards

Health-based standards for chemical parameters are set using a precautionary approach and on the basis of a lifetime’s consumption of water and taking into account other exposure through routes other than drinking water (e.g. food). Just because a standard has been set for a substance does not mean that it is present in drinking water. The vast majority of the regulated chemicals are never found in drinking water in England and Wales at levels approaching or exceeding the standards. Others may occur only in very specific or local circumstances which are described below. A common situation is leaching from fixtures and fittings or pipework within a specific building water system. The chemical parameters for which prescribed concentrations or values are specified in the Water Supply (Water Quality) Regulations 2016 (as amended) are:

Acrylamide monomer is not normally found in drinking water. It is produced in the manufacture of polyacrylamides occasionally used in water treatment. Its presence in drinking water is limited by control of the product specification. The standard is 0.1 µg/l.

Antimony is rarely found in drinking water. Trace amounts can be derived from brass tap fittings and solders. The standard is 5 µg Sb/l.

Arsenic occurs naturally in only a few sources of groundwater. Specific water treatment is required to remove it. The standard is 10 µg As/l.

Benzene is present in petrol. It is not found in drinking water, but it can migrate through underground plastic water pipes if petrol is spilt in the vicinity. Some bottled waters and soft drinks which include sodium benzoate as an ingredient have been reported as containing benzene. The standard is 1 µg/l.

Benzo (a) pyrene is one of several compounds known as polycyclic aromatic hydrocarbons (PAHs). Their source in drinking water is as a result of deterioration of coal tar which was used to line water pipes up until the early 1970s. Due to extensive water mains refurbishment and renewal it is now rare to detect this substance in drinking water. The standard is 0.01 µg/l.

Boron in surface water sources comes from industrial discharges or from detergents in treated sewage effluents. It can be present in partially desalinated seawater when this is used to supplement drinking water supplies. Concentrations found in drinking waters are generally very low. The standard is 1 mg B/l.

Bromate can be formed during disinfection of drinking water as a result of a reaction between naturally occurring bromide and strong oxidants (usually ozone). It may be generated in the manufacture of sodium hypochlorite disinfectant.
Exceptionally, groundwater beneath an industrial site can become contaminated with

bromate. The standard is 10 µg BrO_3/l.

Cadmium is rarely detected in drinking water and trace amounts are usually due to dissolution of impurities from plumbing fittings. The standard is 5 µg Cd/l.

Chromium in drinking water comes from the coatings on some taps and plumbing fittings. The standard is 50 µg Cr/l.

Copper in drinking water comes mostly from copper pipes and fittings in households. In general, water sources are not aggressive towards copper, but problems very occasionally occur on new housing estates or in new installations. These 'blue water' events can be avoided by good plumbing practices. The standard is 2 mg Cu/l.

Cyanide is not normally present in drinking water, but could be present in surface water as a result of a specific industrial contamination incident. The standard is 50 µg CN/l.

1,2-Dicholoroethane is a solvent that may be found in groundwater in the vicinity of industrial sites. Where necessary it can be removed by special water treatment. The standard is 3 µg/l.

Epichlorhydrin can be found in trace amounts in polyamine water treatment chemicals. Its presence in drinking water is limited by control of the product specification. The standard is 0.1 µg/l.

Fluoride occurs naturally in many water sources, especially groundwater. It cannot be removed by conventional water treatment, so high levels must be reduced by blending with another low fluoride water source. In addition, some water companies in England are required by the local health authority to fluoridate water supplies as a protection against tooth decay. No fluoridation takes place in Wales. The standard is 1.5 mg F/l.

Lead very occasionally occurs naturally in raw waters, but the usual reason for its presence in drinking water is lead plumbing in older properties. It can also arise from the illegal use of lead solder in water supply installations. If the water supply has a tendency to dissolve lead then water companies treat the water to reduce consumer exposure. The permanent remedy is for householders to remove lead pipes and fittings. The standard is currently 10 µg Pb/l.

Mercury is not normally found in sources of drinking water in the UK. The standard is 1 µg Hg/l.

Nickel occurs naturally in some groundwater and, where necessary, special treatment can be installed to remove it. Another source of nickel in drinking water is the coatings on modern taps and other plumbing fittings. The standard is 20 µg Ni/l.

Nitrate occurs naturally in all source waters although higher concentrations tend to occur where fertilisers are used on the land. Nitrate can be removed by ion exchange

water treatment or through blending with other low nitrate sources. The standard is 50 mg NO_3/l.

Nitrite is sometimes produced as a by-product when chloramine (a mixture of chlorine and ammonia) is used as the essential residual disinfectant in a public water supply. Chloramine is the residual disinfectant of choice in large distributions systems because it is more stable and long-lasting. Careful operation of the disinfection process ensures that levels of nitrite are below the standards of 0.1 mg NO_2/l in water leaving water treatment works and 0.5 mg NO_2/l at consumers' taps.

Pesticides – organochlorine compounds (aldrin, dieldrin, heptachlor, heptachlor epoxide) are no longer used in the UK because they are persistent in the environment. They are very unlikely to be found in drinking water. The standard for each compound is 0.03 µg/l.

Pesticides – other than organochlorine compounds are a diverse and large group of organic compounds used as weed-killers, insecticides and fungicides. Many water sources contain traces of one or more pesticides as a result of both agricultural uses mainly on crops and non-agricultural uses, mainly for weed control on highways and in gardens. Where needed, water companies have installed water treatment (activated carbon and ozone) so that pesticides are not found in drinking water. The standard is 0.1 µg/l for each individual substance and 0.5 µg/l for the total of all pesticides. Water companies must test for those pesticides used widely in their area of supply. Pesticide monitoring thus varies according to the probability and anticipated nature of contamination.

Polycyclic aromatic hydrocarbons is a group name for several substances present in petroleum-based products such as coal tar. The standard is 0.1 µg/l for the sum of all the substances (see Benzo(a)pyrene listed above for more information).
Selenium is an essential element and a necessary dietary component. Amounts in drinking water are usually well below the standard of 10 µg Se/l.

Tetrachloroethane and Trichloroethene are solvents that may occur in groundwater in the vicinity of industrial sites. Where necessary they are removed by specialist treatment. The standard is 10 µg/l for the sum of both substances.

Trihalomethanes are formed during disinfection of water by a reaction between chlorine and naturally occurring organic substances. Their production is minimised by good operational practice. The standard is 100 µg/l.

Vinyl chloride may be present in plastic pipes as a residual of the manufacturing process of polyvinyl chloride (PVC) water pipes. Its presence in drinking water is controlled by product specification. The standard is 0.5 µg/l.

National Chemical and Physical Standards

The European Drinking Water Directive (DWD) recognises that Member States can set additional standards and the UK has decided to retain national mandatory standards for several parameters set in the original 1980 DWD that have become additional monitoring parameters in the 1998 DWD. Most of the standards are set on the basis that higher levels may make the water unacceptable to consumers on the grounds of taste, odour or appearance.

Aluminium occurs naturally in some source waters. It is removed from drinking water by conventional water treatment (coagulation and filtration). Aluminium sulphate and polyaluminium chloride may be used as water treatment chemicals at some water treatment works. The standard is 200 µg Al/l.

Colour occurs naturally in upland water sources and is caused by natural organics which are characteristic of these catchments. It is removed by conventional water treatment. The standard is 20 mg/l on the Pt/Co scale.

Iron is present naturally in many water sources. It is removed by water treatment. Some iron compounds are used as water treatment chemicals. However, the most common source of iron in drinking water is corrosion of iron water mains. The standard is 200 µg Fe/l.

Odour and Taste can arise as a consequence of natural substances in surface waters, particularly between late spring through to early autumn. Water treatment with activated carbon or ozone will remove these natural substances. The standard is described as acceptable to consumers and no abnormal change in odour or taste.

Sodium is a component of common salt (sodium chloride). It is present in seawater and brackish groundwater. Some water treatment chemicals contain sodium. Concentrations in drinking water are extremely low, but some water softeners can add significant amounts where they are installed in homes or factories. The standard is 200 mg Na/l.

Tetrachloromethane is a solvent that may occur in groundwater in the vicinity of industrial sites. Where necessary it is removed by specialist water treatment.
The standard is 3 µg/l.

Turbidity is a measure of the cloudiness of water. It can arise from disturbance of sediment within water mains. The standard at consumers' taps is 4 NTU (see also turbidity at treatment works below).

On occasion, the measurement of turbidity is carried out by a method other than that specified in the drinking water regulations and the results reported as a quantity of suspended solids. This cannot be easily converted to NTU. Organisations responsible for testing water under the relevant drinking water regulations are required to use the designated methods and report in the units specified in the regulations.

Additional Monitoring Parameters

In addition to the drinking water standards, water companies are required to test for additional indicator parameters to assist them with good water supply management and the control of drinking water quality. Some of these parameters have a European guide value set for the purpose of triggering an investigation of the water supply.

Ammonium salts are naturally present in trace amounts in most waters. Their presence might indicate contamination of sanitary significance and they interfere with the operation of the disinfection process. The guide value is 0.5 mg NH_4/l

Chloride is a component of common salt. It may occur in water naturally, but it may also be present due to local use of de-icing salt, leachate impaction or saline intrusion. The guide value is 250 mg Cl/l.

Conductivity is a non-specific measure of the amount of natural dissolved inorganic substances in source waters. The guide value is 2,500 µS/cm.

Hydrogen Ion (pH) gives an indication of the degree of acidity of the water. A pH of 7 is neutral; values below 7 are acidic and values above 7 are alkaline. A low pH water may result in pipe corrosion. This is corrected by adding an alkali during water treatment. The guide value is a range between 6.5 and 9.5.

Indicative Dose is a measure of the effective dose of radiation the body will receive from consumption of the water. It is calculated only when screening values for gross alpha or gross beta (radiation) are exceeded. The guide value is 0.10 mSv/year.
For more information on monitoring for radioactive substances see;
http://dwi.defra.gov.uk/private-water-supply/regs-guidance/Guidance/info-notes/england/reg-11.pdf

Radon is a radioactive gas that occurs naturally in the environment. The guide value is 100 Bq/l.

Sulphate occurs naturally in all waters and cannot be removed by treatment. The guide value is 250 mg SO_4/l.

Total Organic Carbon represents the total amount of organic matter present in water. The guide value is ‘no abnormal change’.

Tritium is a radioactive isotope of hydrogen. Tritium is present in the environment is mainly of man-made origin, but some tritium is formed naturally as a result of cosmic ray interactions in the upper atmosphere, but these levels are very low. Discharges to the environment are strictly controlled and there is a national programme of monitoring surface waters. The guide value for drinking water sources is 100 Bq/l.

Turbidity measurement is an important non-specific water quality control parameter at water treatment works because it can be monitored continuously on line and alarms set to alert operators to deterioration in raw water quality or the need to optimise water treatment. The standard at treatment works is 1 NTU.

Other Pathogenic Organisms

There are a wide range of pathogenic organisms capable of causing adverse human health effects if they are introduced into drinking water supplies. Contaminated water can be the source of large outbreaks of disease, however, for the majority of waterborne pathogens there are other equally important sources of infection, such as person to person contact and food. The human health effects caused by waterborne transmission vary in severity from mild gastroenteritis to severe and sometimes fatal diarrhoea, dysentery, hepatitis, typhoid fever, cholera, cryptosporidiosis and giardiasis. Most waterborne pathogens are introduced into drinking water supplies in human or animal faeces, they do not grow in water and infection is initiated in the gastrointestinal tract. However, some are environmental organisms that grow in water and soil, and can cause opportunistic infections through other routes of transmission, such as inhalation leading to respiratory infections (legionellosis) or infections at sites as diverse as skin and brain (*Naegleria fowleri*).

For an exhaustive global list of fact sheets on pathogenic organisms potentially associated with water-related infections see Chapter 11 of the WHO Guidelines for Drinking Water Quality[19] Set out below is a summary of the subset of pathogenic organisms of direct relevance to waterborne transmission in the context of UK private and public water supplies.

Bacterial Pathogens

Aeromonas species occur widely in water, soil and food, and are capable of growth in water distribution systems. They are capable of infecting open wounds and septicaemia can occur in immuno-compromised persons. The presence of aeromonads in drinking water is generally considered a nuisance rather than a health hazard. The organisms are detected by colony counts and controlled by good water supply distribution management and hygiene practices.

Campylobacter species are one of the most important causes of acute gastroenteritis worldwide. *Campylobacter jejuni* is the most frequently isolated species from patients with acute diarrhoeal disease. As few as 1,000 organisms can cause infection and most infections occur in infants and young children. Wild and domestic animals, especially poultry, wild birds and cattle, are important sources, other sources include domestic pets and contaminated food and drinking water, including meat and unpasteurised milk. Control of drinking water transmission relies on the protection of raw water sources from

[19] http://www.who.int/water_sanitation_health/publications/2011/dwq_guidelines/en/

animal and human waste, adequate disinfection and protection of stored water from animal and bird faeces.

***Escherichia coli* pathogenic strains:** Most *E. coli* strains are present in large numbers in the normal gut flora of humans and animals. A few strains can cause serious disease (bacteraemisa, urinary tract infections, meningitis) in other parts of the body and some cause acute diarrhoea. These enteropathogenic *E. coli* are identified on the basis of virulence factors and the most well known in the context of waterborne transmission are the enterohaemorrhagice *E. coli* (EHEC), particularly serotypes O157:H7 and O111. As few as 100 organisms can cause infection and up to seven per cent of cases develop a potentially fatal haemolytic uraemic syndrome (HUS) characterized by acute renal failure due to production of two enterotoxins simultaneously. Control of drinking water transmission of pathogenic *E. coli* is the same as that for other *E. coli,* namely raw water protection from faecal waste, adequate disinfection and protection of stored water.

Legionella Although all *Legionella* species are potentially pathogenic for humans, *Legionalla pneumophila* is the major species responsible for legionellosis which occurs in two clinical forms; legionnaire's disease, a pneumonia, and Pontiac fever, a milder respiratory infection. *Legionella spp* are common in surface waters and moist soils, and they grow in warm conditions in the range of 25 – 50 degrees centigrade. Transmission is via inhalation. Control focuses on building water system design and maintenance through minimising the production of water aerosols and limiting growth conditions by keeping cold water cold and hot water hot. Most large waterborne outbreaks have been linked to cooling towers which are poorly maintained, whereas sporadic infections are more commonly linked to hot water systems in large buildings.

Mycobacteria The non-tuberculous or atypical strains are natural inhabitants of water environments. They can give rise to a range of diseases involving the skeleton, lymph nodes, skin and soft tissue as well as respiratory, gastrointestinal and genitourinary tracts. They are a major cause of disseminated infections in immunosuppressed patients and a common cause of death in HIV positive persons. Only two species have been reported in tap water, *M. kansasii* and *M. avium* complex. Water-related infections due to the latter have been attributed to unfiltered water supplies and *M. kansasii* has been found in domestic showers and hospital water systems in the Netherlands and UK respectively.

The organisms are more resistant to disinfection with chlorine than other bacteria, such as coliforms, therefore control relies on treatment by filtration and effective management of distribution systems to minimise growth conditions and maintenance of a persistent level of residual chlorine.

Pseudomonads are common environmental organisms with similar characteristics to Aeromonads (see above). *Pseudomonas aerugionsa* is capable of growing on specific construction materials used in building plumbing systems, swimming pools and spas. Exposure to high numbers in water in the latter settings can cause folliculitis (rashes) and ear infections, and the organism can infect wounds and give rise to septaceamia

and meningitis in the immunosuppressed patient. Control is through the use of suitable approved materials in the design of pools, spas, plumbing systems and water mains.

Incidences of high numbers of the organism in packaged waters has been associated with complaints of taste and odour, and this has resulted in a monitoring standard of <1 per 250ml being set for bottled waters. Bottled water guidence can be found at https://www.food.gov.uk/business-guidance/water-guidance-for-wales-and-northern-ireland. There is no equivalent standard for public water supplies due to the fact they are not normally in packaged form.

Salmonella spp species cause either gastroenteritis, septicaemia, enteric/typhoid fever and can remain in a carrier state in previously infected persons. Typically diarrhoea is accompanied by fever and abdominal pain which is self-limiting, but infection with *S. typhi* and *S. paratyphi* (typhoid strains) is more serious and can be fatal. Waterborne typhoid fever outbreaks have devastating public health implications. The typhoid strains are restricted to humans, but others such as *S. typhimurium* and *S. enteritidis* occur in a wide range of livestock, including poultry. Contamination has been detected in many foods and milk, and these pathogens gain access to water sources from sewage discharges, livestock and wild animals. Control measures involve protection of raw water from animal and human waste, adequate disinfection and protection of stored water from animal and bird faeces.

Shigella spp cause serious intestinal diseases mostly in young children, including bacillary dystentery. Only 10 – 100 organisms are required to cause infection resulting in severe watery diarrhoea, abdominal pain and fever. A milder self-limiting disease is caused by the *S. sonnei* strain. The organisms are restricted to humans and higher primates with most cases of shigellosis occurring in the institutional setting due to poor sanitation.

Prevention of waterborne outbreaks is important due to the severity of the illness caused and control is by protection of raw and treated water from human waste combined with adequate disinfection.

Toxic Cyanobacteria are photosynthetic bacteria that share some properties in common with algae, hence they are commonly known as blue green algae. However, there are many which are not blue green and can range in colour from yellow to brown and red. Cyanobacteria are common in the environment occurring in soil, sea water and freshwater. Sunlight and warm weather stimulate growth especially in stagnant waters or low flow conditions and in the presence of high nutrient levels (eutrophic waters). Some will form floating surface blooms or scums, others stay mixed in the water column or are bottom dwelling (benthic). Their public health significance derives from the ability of some species to form toxins. At least 13 toxin producing species have been identified and each toxin has specific properties with distinct concerns, including liver damage, neurotoxicity and tumour production. Acute symptoms after exposure include gastric disorders, fever and irritations of the skin, ears, eyes, nose and throat. Cyanobacteria do not multiply in the body and hence they are not infectious. Control relates to source

water abstraction management and the minimisation of algal blooms together with prevention of direct recreational contact with algal blooms and by excluding light from stored water tanks.

Vibrio spp Non-toxigenic strains are widely distributed in water environments, but toxigenic strains occur in water less often because they are generally limited to humans, although they have been found inside aquatic organisms like crustaceans and algae. The prevalence of *V. cholerae* declines notably in colder waters (below 20 degrees centigrade).Illness symptoms are due to the production of the cholera enterotoxin. The majority of those infected do not develop illness, however those who do will experience characteristic 'rice water stools' and suffer severe dehydration and loss of electrolytes which is fatal without treatment. High numbers of organisms are required to cause infection, therefore person to person contact is not the main cause of spread and serious outbreaks are due to poor sanitation and ingestion of faecally contaminated food and water. Control is by protection of raw water from human waste, adequate disinfection and protection of stored water.

Viral Pathogens

Viruses associated with waterborne transmission are predominantly those that infect the gastrointestinal tract and are excreted in human faeces (enteric viruses). As a group, viruses can cause a wide variety of infections and symptoms involving different routes of transmission, sites of infection and routes of excretion. It is worthy of note that viruses responsible for respiratory infection can be discharged in faeces and contaminated water may therefore be a route of transmission through aerosols and droplets. It is also thought that polyomaviruses excreted in urine and linked to long-term health effects have the potential for waterborne transmission. An important issue for control of waterborne transmission is the fact that viruses generally survive better in water, particularly in cold climates, than bacterial indicator organisms. Consequently, satisfactory indicator test results do not preclude the presence of viruses. Another important factor to be considered is the greater resistance of viruses to disinfection compared to bacteria.

Adenoviruses Infections have been linked to consumption of contaminated food and drinking water, although person to person spread through shared utensils and contaminated surfaces in the institutional setting is the more common source of outbreaks of gastroenteritis. Eye infections have been linked to the sharing of towels and goggles when swimming. These viruses consist of double stranded DNA and generally do not grow in cell culture, therefore detection relies on polymerase chain reaction (PCR) techniques. Control is made problematic because human adenoviruses are exceptionally resistant to disinfection, especially UV light irradiation. Protection of raw and treated water is therefore very important to control risks from drinking water supplies.

Astroviruses are single stranded RNA viruses detected in environmental samples by PCR techniques. They cause self-limiting gastroenteritis in young children and infected

individuals excrete large numbers of the virus in faeces, hence the viruses will be present in sewage. Person to person spread in day care, home settings and institutions is common. Contaminated food and water may be an important route of transmission. Control measures are the same as for Adenoviruses although UV maybe more effective.

Caliciviruses are single stranded RNA viruses which include the genera Norovirus (Norwalk like viruses). The human caliciviruses are a major cause of acute viral gastroenteritis in all age groups. Symptoms include nausea, vomiting and abdominal cramps. Less than half of those infected present with diarrhoea and some have a fever. Known as winter vomiting disease the symptoms are relatively mild and self-limiting, however the high attack rate denotes a low infectious dose. Since the virus is excreted in faeces it will occur in domestic waste water as well as contaminated food and drinking water. Numerous water-related outbreaks have been documented in relation to recreational water, ice, water on cruise ships, other drinking waters and shellfish harvested in polluted estuarine waters. Control measures relate to the protection of raw and treated water from faecal contamination and adequate disinfection.

Enteroviruses are a wide group of viruses which include poliovirus, coxsackievirus, echovirus. They are the smallest viruses and consist of a single stranded RNA genome. Many can be detected in environmental samples by cell culture. Enteroviruses are all excreted in the faeces of infected individuals and are therefore the most numerous viruses in sewage and sewage polluted waters, however the predominant route of transmission is by person to person contact and inhalation. Control measures relate to the protection of raw and treated water from faecal contamination and adequate disinfection.

Hepatitis A is highly infectious and the infecting dose is low. Like other enteric viruses, Hepatitis A virus enters the gastrointestinal tract by ingestion where it infects epithelial cells and then enters the bloodstream to reach the liver where it can cause severe damage in around ten per cent of adult cases. There is a long incubation phase of around 30 days followed by a characteristic onset of symptoms, such as fever, malaise, nausea, anorexia and eventually jaundice. The evidence for waterborne transmission of Hepatitis A is well documented and stronger than it is for all other viruses. Food borne outbreaks are also relatively common. Travel of people from areas with good sanitation to those with poor sanitation is associated with a high risk of infection, as is drug abuse. Control measures relate to the protection of raw and treated water from faecal contamination and adequate disinfection.

Hepatitis E is similar in its effects to Hepatitis A, however, the incubation period for infection is longer and there is a high mortality rate in pregnant women. Currently cases and outbreaks are rare in the UK. Control measures are the same as Hepatitis A above.

Rotavirus are double stranded RNA viruses some of which infect humans while others are specific to animals. They are not grown readily in cell culture, but can be detected in environmental samples by PCR techniques. Human rotaviruses are the most important single cause of infant death in the world. The virus infects cells in the villi of the small

intestine and disrupts sodium and glucose transport. Person to person transmission and inhalation are the important routes of spread, however, both water and food borne outbreaks are documented. Rotavirus may be more resistant to conventional disinfection techniques than other viruses. Control measures are the protection of source and treated water from contamination by human faecal wastes, and careful attention to adequate treatment and disinfection of drinking water prior to supply to consumers.

Protozoan Pathogens

Protozoa are common causes of human and animal infection which present real challenges for control because most produce cysts or oocysts that are extremely resistant to disinfection and survive for long periods in water and the environment.

Ancanthamoeba is a free living amoebae common in water and soil. Under unfavourable conditions it develops a dormant cyst capable of withstanding extremes of temperature (-26 to 56 degrees C). Cases of acanthameobic keratitis, a painful infection of the cornea, have been associated with the use of tap water in preparing solutions for washing contact lenses. It is a rare disease but may lead to impaired vision, blindness and loss of the eye. Since the cleaning of contact lenses is not considered to be a normal domestic use of tap water, control is through the purchase and use of proprietary, sterile, lens cleaning solutions.

Cryptosporidium This parasite has a complex life cycle which causes a self-limiting, but prolonged unpleasant, diarrhoeal illness in humans and animals. It forms oocysts which are shed in faeces in very high numbers. The main route of infection is by person to person spread and by direct contact with farm animals and sometimes pets. However, outbreaks due to faecally contaminated drinking water are widely documented. Ingestion of ten oocysts or fewer can lead to infection. The oocysts are very resistant to chlorine, therefore control is achieved by source water (catchment) protection, filtration and disinfection with UV irradiation. For information on *Cryptosporidium* in drinking water is available on DWI's website[20]

Health teams are advised that they liaise with the local water company to review Cryptosporidium monitoring data if a change in the number or distribution of cases of cryptosporidiosis notified by diagnostic laboratories is observed.

Any trigger level for notification by the water companies to health teams and thresholds for action will need to vary depending on many factors, not limited to but including: the treatment in place at the water treatment works and its performance, the historical results for the works, and the population served. Features of the parasites present (such as their potential infectivity for humans) are also part of the equation but that information may not be available or only obtained later. Review on a case-by-case basis therefore forms a pragmatic approach. It is therefore important to keep ongoing communication with the water companies.

[20] http://www.dwi.gov.uk/research/bouchier/index.htm

Giardia is a protozoan which colonises the gastrointestinal tract of humans, and some animals, forming a thick walled cyst which is shed intermittently in faeces. It causes diarrhoea and malabsorption in the small intestine. Illness is generally self-limiting, but can be chronic, lasting over one year, in otherwise healthy people. As few as ten cysts are required for infection. The cysts survive for months in water. Person to person contact is the commonest route of transmission between children. Although more resistant to disinfection with chlorine than bacterial pathogens, unlike *Cryptosporidium*, chlorination can be used as a control measure together with filtration and source water protection.

Naegleria fowleri is a free living amoeboflagellate distributed widely in the environment which forms resistant cysts under unfavourable conditions. It causes primary amoebic meningocephalitis in healthy people by entering the brain through penetration of the olfactory mucosa. The disease is acute and patients often die within ten days before diagonosis. Cases are rare, but occur every year. Naegleria are thermotolerant and found in warmer waters such as hot springs and swimming pools or spas. Infection is contracted by exposure of the nasal passages to contaminated water and thus predominantly associated with recreational water uses. Control is by means of reducing water temperature (below 25 degrees C) and the maintenance of a stable and effective residual chlorine level of at least 0.5 mg/l.

Other Chemicals

Perfluorooctane sulphonate (PFOS) and perfuoroocanoic acid (PFOA) may be present in the environment and water sources as a consequence of their historic use as firefighting foams. DWI has issued guidance based on PHE advice on trigger levels for monitoring and notification in respect of both these substances (http://dwi.gov.uk/stakeholders/information-letters/2009/10_2009annex.pdf).

N-nitrosodimethylamine (NDMA) is a by-product of industrial processes that use nitrate and/or nitrite and amines. It can also be formed during sewage treatment and during water treatment as a disinfection by-product. It is generally accepted as being a genotoxic carcinogen. DWI has issued guidance based on PHE advice on trigger levels for monitoring and notification in respect of this substance (DWI Information Letter 07/2012).

Chromium VI is a toxic form of the chromium element and DWI has provided some advice on this chemical. (DWI Information Letter 02/2017: http://dwi.gov.uk/stakeholders/information-letters/2017/02-2017.pdf)

Other Resources

Other resources for public health advice of microbiological contaminants include:

- PHE webpages – https://www.gov.uk/topic/health-protection

- PHW webpages - https://phw.nhs.wales/
- Cryptosporidium Reference Unit - https://www.gov.uk/guidance/cryptosporidium-reference-unit-cru

Some additional resources for public health advice on chemical and radiological contaminants include:

- PHE's Chemical Hazards Compendium https://www.gov.uk/government/collections/chemical-hazards-compendium
- Section 8.7 of the WHO publication, Guidelines for Drinking Water Quality (4th Edn.), which identifies local actions in response to chemical water quality problems and emergencies. In particular sections 8.7.3 and 8.7.4 in relation to talking to the right people and public advice. http://www.who.int/water_sanitation_health/publications/drinking-water-quality-guidelines-4-including-1st-addendum/en/
- In England, refer to local HPT and PHE CRCE duty desk for advice: email crce-ehe@phe.gov.uk
- In Wales, refer to local Health Board and CRCE Wales for advice.

Annex 2: Content of Notifications about Drinking Water Quality Events

Set out below is the template used by DWI Inspectors when contacted by a water company making the initial notification of a water quality event. The text in italics indicates the nature of the information that DWI expects the company to provide as a minimum at the outset of an event. This is the type of information that a CCDC can expect to be provided with by a water company when they first contact a CCDC with a view to obtaining health advice. Typical additional questions that a CCDC may want to ask the water company to enable a health risk assessment to be made are listed below.

DWI Water Quality Event Notification Template

Company	*Water supplier making the notification and responsible for the affected water supply, if more than one water company is affected by a water quality event then each one will notify their particular circumstances*
Name of event	*Water company description of the event which will be used throughout the management and subsequent investigation of the event, usually takes the form of nature/location descriptor, e.g. burst trunk main in Essex Road, Islington*
Person making the notification	*Name of water company person making the notification and responsible for ongoing updates*
Date and time of notification	*Time/Date when DWI Inspector received notification*
Date/Time/Location of event	*Time when company first became aware of an event and the location of the assets first affected, e.g. works, reservoir, street*
Nature of event	*Water company description of what has happened, typically a description of the impact, e.g. discoloured water and low pressure complaints from consumers; report received from Environment Agency of dead fish one mile upstream of abstraction intake at N works; sample result from X location with a result of Y etc.*
Population and Area affected	*Estimate of population resident in the water quality zones potentially affected by the event, together with names of the water quality zones.*

Likely cause(s)	*Water company initial assessment of the cause of the event, e.g. third party damage to a water main; illegal discharge from a factory into the River X etc.*
Action taken to inform/protect consumers and details of risk	*Details of:* *advice issued to consumers, e.g BWA notice* *alternative supplies provided* *any customer call centre/website tape recorded message*

Action being taken to rectify the situation	*Details of the action already taken and planned to restore the water supply to normal*
LAs/HAs informed?	*Name of person notified in the relevant local authorities and the Health Protection Unit of PHE/PHW and the nature of any advice provided and/or any conference calls/meetings arranged*
Level of publicity	*Details of any media awareness*

Additional information that may be required to support a health risk assessment by PHE.

1. Description of affected water supply from source to tap, in particular, details of source water (surface, ground), water treatment in use and/or proposed either temporarily/permanently, treated water storage (service reservoirs, towers, tanks, tankers, bowsers, bottles), distribution mains (details of planned or unplanned work and nature of materials if work on mains involved), nature of building (public, private, social care, office, factory etc.) including any high risk premises in respect of back flow prevention inspection.
2. Nature of any actual or suspected contaminants (chemical, biological, radiological) and concentration of any contaminant/organism, including details of samples already taken and samples planned to be taken.
3. Historic water quality testing data (should also refer to drinking water, annual report by DWI if the event relates to a known or ongoing problem).
4. UKWIR (for example Toxicological Datasheets or Microsheet Data) or WHO information about the contaminants/organisms.
5. Technical information about any loss of, or proposed changes to, water treatment, including disinfection at works, also details of addition of chlorine to the network or service reservoirs (DWI is the source of advice on approved treatment chemicals, treatment performance and operational best practice).
6. For incidents at a works or a service reservoir, an estimate of the time required for the contaminants/organisms to pass through the water supply system under normal operating conditions and, where relevant, any remedial measure, such as removing assets from supply, rezoning or high velocity flushing, which may affect these time estimates (the water industry and the Environment Agency have time of travel models for river pollution incident.

Annex 3: Examples of Precautionary Notices for Consumers

The following pages provide suggested templates that could be used by authorities with powers to issue restriction notices. While companies generally have their own notices, there has been a demand for templates that could be used by other authorities (local authorities). Examples provided below include ‘Boil water’ notice, ‘Do not drink’ notice, ‘Do not use’ notice and also an ‘All clear’ notice used to inform consumers of the return of normal supplies. These are available as Microsoft Word templates on the DWI website. It is important that they are branded by the authority using them in the normal manner for their communication with customers as this will allow consumers to understand who is issuing the instructions and will be able to identify with the normal branding.

Boil Water Notice

Text box to identify the name of the issuing authority and any relevant 'branding'

This is an instruction to

BOIL YOUR TAP WATER

UNTIL FURTHER NOTICE

USE **BOILED** AND COOLED TAP WATER FOR

- Drinking/cleaning teeth
- Cooking
- Making Ice
- Making up babies' feed
- For pets

YOU CAN USE **UNBOILED** WATER FOR

- Bathing
- Washing clothes
- Washing dishes
- Flushing the toilet

You will be advised by [insert name of organisation that will rescind the BWN] when your supply is back to normal.
For any questions about this instruction please contact [insert name of organisation providing advice]

Do Not Drink Notice

Text box to identify the name of the issuing authority and any relevant 'branding'

This is an instruction

DO NOT DRINK YOUR TAP WATER UNTIL FURTHER NOTICE

DO NOT USE TAP WATER FOR

- Drinking or cleaning teeth
- Cooking or preparing food or babies' feed
- Making Ice
- For pets' water

TAP WATER CAN BE USED FOR

- Washing and bathing
- Washing clothes
- Washing dishes
- Flushing the toilet

You will be advised by [insert name of organisation that will rescind the BWN] when your supply is back to normal.
For any questions about this instruction please contact [insert name of organisation providing advice]

Do Not Use Notice

Text box to identify the name of the issuing authority and any relevant 'branding'

This is an instruction

DO NOT USE YOUR TAP WATER UNTIL FURTHER NOTICE

DO NOT USE TAP WATER FOR

- Drinking or cleaning teeth
- Cooking or preparing food or babies' feed
- Making Ice
- For pets' water
- Washing and bathing
- Washing clothes or dishes

TAP WATER CAN BE USED FOR

- Flushing the toilet [amend depending on nature of issue]

You will be advised by [insert name of organisation that will rescind the BWN] when your supply is back to normal.
For any questions about this instruction please contact [insert name and contact details of organisation providing advice]

All Clear Notice

Text box to identify the name of the issuing authority and any relevant 'branding'

This is an instruction

YOU MAY NOW USE YOUR TAP WATER

- Your tap water supply is now back to normal
- Please run your taps to make sure that fresh water is drawn through the system before using it.

For any questions about this instruction please contact [insert name and contact details of organisation providing advice]

Annex 4: Advice on Precautions to be taken by the Immunosuppressed Individual in Relation to Boil Water Notices

CMO's Update - a communication to all doctors from the Chief Medical Officer

The Bouchier Report *Cryptosporidium* in Water Supplies: Third Report of the Group of Experts (1998)[21] included advice for the immunosuppressed. This was publicised in the February 1999 edition of Chief Medical Officer's (CMO) Update 2. A working group of specialists chaired by Professor Ian Bouchier then defined further which groups of immunosuppressed patients are at particular risk of cryptosporidiosis infection and should boil their drinking water in the August 1999 edition of the CMO's update[22]. The level of T-cell function and the duration of any immune suppression were considered to be crucial factors in susceptibility to Cryptosporidium. The group concluded that the advice should be that anyone whose T-cell function is compromised (this includes people with HIV infection who are immunosuppressed, children with severe combined immunodeficiency (SCID) and those with specific T-cell deficiencies, such as CD40 ligand deficiency, also known as Hyper IgM Syndrome), should be advised to boil and cool their drinking water from whatever source. This includes tap or bottled water, and ice cubes should also be produced from boiled and cooled water.

It is especially important to boil water from a private water supply serving a property (or properties), even with UV treatment, as this will not have any residual disinfection, and also where there is a potable supply where outlets do not come direct from the rising main, e.g. where a storage tank is used. This advice would also extend to avoiding the use of un-boiled water for cleaning teeth. See http://www.dwi.gov.uk/stakeholders/guidance-and-codes-of-practice/Boiling-water01-15.pdf

Any particularly vulnerable sub-group should be risk assessed and advised by their managing clinical consultant to take additional precautions as appropriate

UK guidance on the safety of various types of bottled water is to be found on the NHS choices web site for use by infants. The salt and sulphate content of bottled water may not be sufficiently low for infant formula. https://www.nhs.uk/common-health-questions/childrens-health/can-i-use-bottled-water-to-make-up-baby-formula-infant-formula/

[21] *Cryptosporidium* in Water Supplies – Third Report of the Group of Experts to: Department of the Environment, Transport and the Regions & Department of Health. Chairman Professor Ian Bouchier November 1998. HMSO

[22] http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4013568.pdf

guardians of drinking water quality

Drinking Water Inspectorate | Nobel House | London | SW1J 3JR

Tel: 0300 068 6400 | http://www.dwi.gov.uk