Principles of Water Supply Hygiene

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Foreword

It is well known that water has the potential to transmit disease and that keeping properly hydrated is essential to good health. It is therefore vitally important that those whose business it is to supply water take all possible precautions to protect drinking water quality at every stage from its collection in the catchment, through its treatment and distribution, all the way to the point it emerges from the tap.

The UK has an excellent record of providing public water supplies that are safe to drink. There is, however, a need for constant vigilance to assure the wholesomeness of supplies. From a clear understanding of the ever-present risks of waterborne illness, has come the development of water supply hygiene safeguards. Since the 1930s, these safeguards have guided water suppliers in the practices and procedures they should follow.

The UK has a comprehensive regulatory system for maintaining water supply quality based around the proactive management of risk and a holistic approach to drinking water safety. The maintenance of robust hygiene practices lies at the heart of this and forms an essential control measure in the protection of human health.

Water UK's members agree to the following commitments in the pursuit delivering a secure supply of safe, wholesome drinking water.

- To ensure all involved in the treatment and supply of drinking water recognise the direct link between hygienic practices and public health;
- To ensure that the principles and good practice outlined in this document and the associated Technical Guidance Notes are incorporated into internal operational procedures and fully implemented;
- To ensure the competency, accountability and training of staff and contractors working on drinking water delivery;
- To work with stakeholders to maintain awareness and understanding of existing and evolving risks to the hygienic supply of drinking water.

It is of upmost importance that consumers trust in tap water supplies, that has been hard won over many decades, is never lost.

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1 Introduction

1.1 Purpose

This document sets out the principles to be considered by drinking water quality specialists in water undertakers in drawing up operational procedures for maintaining safe and wholesome drinking water supplies with specific focus being given to hygiene.

The material in the document is not exhaustive nor is it prescriptive and should be used in accordance with company experiences and specific advice available from a variety sources such as government guidance, information letters from drinking water regulators, water industry research and appointed committees, the proceedings of seminars and journals and textbooks on water supply practices.

Robust water hygiene practices underpin many aspects of a risk-based approach to managing water supplies and these principles are therefore intended to support water undertakers in the development and maintenance of drinking water safety plans.

Demonstration of an understanding of these principles is an important factor for any "new entrant" organisation wishing to provide public water supplies and will also be of use to those managing private water supplies or temporary events.

1.2 The need for precautions

To maintain the excellent record of providing safe water supplies in the United Kingdom in recent years, water undertakers must continue to be vigilant and recognise and assess all hazards (natural or anthropogenic) that may lead to the contamination of water supplies. Water treatment plant and distribution systems must be designed and operated to minimise any risks. Water undertakers must develop and maintain rigorous and effective procedures to prevent deterioration in water quality in their day-to-day operations.

Protection against the risks of contamination should not rely upon a single line of defence. Wherever practicable, there should be multiple barriers consistent with the nature of the hazard to reduce the chance that a breach in any single system could lead to contamination of water supplies.

There has been a trend towards an increased use of independent contractors in the day-to-day operation of water supply systems. It is essential that all those involved in the production and distribution of drinking water, whether employees of a water undertaker or of a contractor, should understand the need for precautions. They must follow the procedures developed to ensure that water quality standards are maintained at all times.

1.3 Definitions

Throughout this document the following definitions are used:

- 'Water undertaker', means any organisation licensed to provide a public water supply as defined in the Water Industry Act 1991.
- 'Clean', means a normal domestic standard of cleanliness, free from faecal matter, dirt or any other contaminating substance.
- 'The Regulations' mean Water Supply (Water Quality) Regulations 2016, Water Supply (Water Quality) Regulations Wales 2010 as amended, Public Water Supplies (Scotland) Regulations 2014 as amended, Water Supply (Water Quality Regulations) Northern Ireland 2007 as amended
- 'Restricted areas' means defined areas within locations where water is prepared for supply, or where it is considered to be in supply in these areas of the site, including boreholes, wells, springs, treatment works, pumping stations, service reservoirs and all pipes in distribution systems to the customer's premises
- 'Restricted operations' means any work which may involve direct or potential contact with untreated sources of underground water, with partially or fully treated water within water treatment works, or any surface of an operational asset (including those temporarily out of use) which will itself be in contact with potable water at any stage in its distribution to the point where it is made available to

consumers.

2 Hygienic practices

2.1 Drinking water is a food product

The production and distribution of drinking water is analogous to food processing and distribution therefore it is of the utmost importance that a high standard of personal hygiene is maintained at all times by all water supply personnel, both water undertakers and contractors

2.2 Restricted operations

Restricted operations are those water supply and distribution activities which, by their nature, carry a greater risk of contamination than others (see 1.3 Definitions). Water undertakers should identify these tasks and the personnel who may be required to work on them.

Appropriate control measures should be established. For example, anyone undertaking restricted operations must therefore be registered on an approved hygiene scheme and carry a valid water hygiene training card.

2.3 Multifunctional working

To minimise the risk of contamination, it is advisable to keep to a minimum, the number of personnel that are required to work on both water and sewage installations. However, it is accepted that some personnel may be required to work on both clean water and wastewater installations. In such situations, it is imperative that procedures are in place to minimise the risk of cross contamination. These procedures will include the need for individuals working on both water and sewage installations to be properly trained and authorised.

The following paragraphs suggest minimum requirements should be in place for those personnel routinely working on both water and wastewater operations.

2.4 Toilets and washing

Water undertakers and contractors should ensure that there is adequate provision of toilet and washing facilities to enable all personnel working on restricted operations to maintain the highest standards of personal hygiene. Especially in the case of portable or temporary arrangements, all wastes must be disposed of without risk to water supplies or to the environment.

To achieve this, it is essential that vehicles deployed for use on restricted operations in remote areas (e.g.: during the repair of distribution mains) should be equipped with hand sanitising facilities.

2.5 Clothing & Tools

Protective clothing (including footwear) used by staff on restricted operations should be readily identifiable. Under no circumstances should clothing that has been used on wastewater operations be worn within defined restricted areas. Clothing should be clean, free from contamination and be stored apart from other protective clothing.

Tools for use in restricted areas should be similarly clean, free from contamination and disinfected before use. Separate tool sets should be used for water and wastewater operations and be clearly marked or identifiable to distinguish between purposes.

Tools and other equipment to be used on restricted operations should be stored in designated areas. Particular attention should be paid to the potential for contamination from fuel oil and other similar chemicals.

If specialist equipment is needed for use on both water and wastewater facilities, then specific and individual risk assessments must be carried out prior to use and approved by drinking water quality specialists within the undertaker. Suitable decontamination protocols should be available.

2.6 Tankers and bowsers

Water tankers used directly for supplying drinking water should not be used for other purposes. Particular attention should be paid to their cleanliness. Water undertakers should satisfy themselves that tankers and bowsers to be used for conveying potable water meet regulatory requirements and are protected from contamination during use. Further considerations are outlined in Technical Guidance Note 12.

Vehicles used for carrying and handling sewage or sewage sludge should only enter water treatment sites for specifically approved purposes (e.g.: removal of sludge). Sewage sludge tankers must not be used for conveying drinking water in any circumstances.

2.7 Other vehicles

Dedicated vehicles should be available for use on restricted operations. Where this is not possible, for example in the case of specialised vehicles (e.g. excavators which have been in contact with sewage, sewage sludge or spray from wastewater treatment processes), specific and individual risk assessments must be carried out prior to use and appropriate controls approved by drinking water quality specialists within the undertaker.

2.8 Stores and workshops

Procedures should be in place in workshops and stores to prevent cross contamination between equipment used for water supply and other uses. Tools and equipment which come into contact with water should be cleaned and disinfected before use in restricted operations.

Pumps and hoses should be clearly identified for drinking water use only and should be made of materials that are approved for use with drinking water (see section 9). They should be stored separately, protected from contamination, not be used for any other purpose and be disinfected prior to use.

2.9 Storage of Pipes and Fittings

Pipes and fittings for use in water supply should be stored raised above ground level and protected from contamination by the use of end caps or similar.

Although the largest diameter pipes (normally >600mm) are not routinely supplied with end caps, undertakers should take precautions to prevent contamination. Pipes and fittings that, on inspection, may have become contaminated, for example having been stored without satisfactory end cap protection, must be cleaned and disinfected prior to deployment.

3 Hygiene Training

All individuals working on restricted operations must have been trained and authorised under an approved water hygiene scheme. Authorisation will be time limited and require repeat training and authorisation before renewal. Cards must be carried at all times by any individual working on restricted operations.

It is recommended that regular audits are carried out to ensure all individuals working on restricted operations are in possession of a valid card. Any individual who cannot produce their valid card proving authorisation under an approved training scheme should be suspended from undertaking restricted operations.

Individuals who flagrantly or repeatedly breach hygiene standards in the course of their duties should be suspended from carrying out work on restricted operations and their authorisation may be revoked whilst appropriate retraining is undertaken.

In addition, it is recommended that water undertakers carry out additional detailed training in respect of specific restricted operations tasks such as mains disinfection, flushing and sampling.

Consideration should also be given to the hygiene awareness of other individuals who, whilst not involved in restricted operations, regularly visit sites unsupervised in carrying out their duties.

4 Medical Surveillance of Personnel

All individuals working on restricted operations and authorised under an approved water hygiene scheme will have received initial medical assessment.

Water undertakers and contractors must have procedures in place to ensure that personnel working on restricted operations who develop symptoms of certain infectious diseases report the fact to their supervisors as well as seeking medical advice.

Personnel who have been identified as having

had illnesses such as infective jaundice, gastroenteritis, persistent diarrhoea or prolonged unexplained fevers should be excluded from restricted operations until clearance has been obtained from the water undertaker. This must be a matter of record.

Further details of Medical Screens are included in Technical Guidance Note 1.

5 Source Protection

5.1 Surface and ground water protection

No source of raw water can be considered as free from the risk of contamination. Water undertakers should use the "Source-Pathway-Receptor" concept inherent in a Drinking Water Safety Plan approach to identify, assess and where necessary, investigate hazards to drinking water quality, beginning at a catchment level.

In the context of water supply hygiene, the following general principles of risk management apply:

- Regular inspections of catchment areas are needed to identify potential hazards to water quality. Operatives carrying out such inspections need to be aware of hygienic practices when accessing restricted areas;
- Water undertakers should engage with relevant stakeholders such as the local environmental regulator, landowners and catchment users to understand potential impacts of any activity;
- Water undertakers should establish procedures to mitigate risks from pollution emergencies and the potential health risks that may result.

5.2 Recreation and public access

Water undertakers have a statutory duty to take account of recreation and nature conservation in the management of land under their control. In carrying out this duty however, there should be due regard for the essential protection of water supply quality. Where there is public access, appropriate arrangements should be made to protect water quality by controlling the type of activities permitted and by ensuring satisfactory disposal of wastes from any toilet facilities provided.

Further details on Catchment Management are included in Technical Guidance Note 7.

6 Water Treatment

Water undertakers are required to carry out comprehensive risk assessments of all stages of the supply of potable water from its source to the tap. Drinking water safety plans should identify the degree of treatment required along with all the hazards and potential hazardous events inherent in the operation of water treatment plants and the necessary control and monitoring measures required to eliminate or mitigate the risks of such hazards.

6.1 Monitoring water quality

The purpose of monitoring is to confirm that the treatment process as a whole continues to be capable of achieving the required water quality, that the individual treatment processes are being adequately optimised and as a validation and verification of the implemented control measures.

Continuous monitoring should be undertaken for key parameters critical to the treatment process employed and sampling should be at a sufficient frequency, and for appropriate determinands, in order to establish and confirm the general water quality and identify significant variation (such as seasonal variation, etc.). Any unexplained deterioration in water quality should be investigated and acted upon.

The Regulations give statutory minimum frequencies for monitoring the quality of final treated water. Water undertakers should consider the need for additional operational monitoring of water during its treatment, to confirm the satisfactory operation of the treatment processes and in distribution, to provide sufficient information regarding water quality generally and to give early indication of any developing deterioration in the quality of supplies.

TGN15 provides good practice advice and guidance on the installation and maintenance of final water and service reservoir sampling taps.

6.2 Disinfection

The Regulations (e.g. Regulation 26 of the Water Supply (Water Quality) regulations 2016 in England or equivalent in devolved administrations) require all drinking water to be disinfected effectively prior to supply.

Water undertakers must have disinfection policies in place to achieve this objective at all water treatment works. Any failure of disinfection is serious and represents a potential risk to public health.

Risk assessments should inform the overall treatment process required including which disinfection processes are needed or may require modification to respond to changes in raw water quality.

Plant and processes used in the treatment of water should be designed and operated to prevent undisinfected water leaving the works and entering the supply in the event of disinfection failure. Where this is not possible appropriate and robust contingency plans must be in place to ensure the protection of public health.

Further information on disinfection, and also on preparation of chlorine solutions and disposal of chlorinated water, is included in Technical Guidance Notes 8, 13 and 14 and also in guidance issued by regulators.

6.3 Water treatment chemicals

Chemicals used in the treatment of water must meet the requirements of the Regulations (e.g. Regulation 31 of the Water Supply (Water Quality) Regulations 2016 in England or equivalent in devolved administrations. Products must be approved under the Regulations or meet the BS/EN standard classification as being suitable for use with potable water.

The process for approval of new treatment chemical products is controlled and managed by the DWI. For further guidance see Section 9. Products and processes should be used in accordance with manufacturers' information and guidance as DWI approval does not indicate effectiveness of a particular treatment other than it has no adverse health effects if used as described.

Water undertakers must have appropriately designed chemical storage facilities, and have clearly defined procedures in place for procurement, delivery, receipt and use of water treatment chemicals to prevent inadvertent contamination of the water supply.

6.4 Plant maintenance

Hygiene should be an integral part of plant maintenance and its importance should be incorporated into maintenance contracts. Water undertakers should ensure that process plant is maintained and inspected and chemical dosing and monitoring equipment is serviced and calibrated at appropriate frequencies and by competent personnel.

All maintenance activities that may have an adverse impact on water quality should be subject to a prior risk assessment and appropriate controls identified and implemented to minimise risk.

Appropriate standby plant, chemicals and fuel required for each treatment facility should be provided and regularly assessed to determine its operability.

Arrangements for the maintenance and inspection of treated water reservoirs and tanks (Section 7) should equally be applied to similar facilities at water treatment works that are used to store partially treated water. Maintenance should include checks of barriers installed for the prevention of vermin access, such as ventilator gauzes.

6.5 Plant supervision and security

The operation of a water treatment plant requires experienced and well-trained staff who understand the principles and processes of water treatment. Water undertakers should ensure that staff are adequately trained and that specialist technical expertise is available to advise and authorise alterations to treatment.

Visitors to water treatment works should be strictly supervised and should not be given

access to areas of restricted operation.

Unattended and remote water installations are vulnerable to vandalism or deliberate interference. Water undertakers should take necessary steps to prevent unauthorised access by careful design of new facilities and by any appropriate means of security or detection at all sites in accordance with current water industry security standards.

6.6 Competent operator

The operation of water treatment processes by competent personnel is an essential element of water quality assurance. As a consequence of the competition provision in the Water Act 2003, a framework for the competency standards required for 'operators' working within water treatment works was agreed by representatives from DWI, UK water companies and EU Skills. The framework requires that all individual operators are assessed and receive the necessary training prior to them being declared as competent and authorised to work.

This framework (The Competent Operator Scheme") states that training and assessment is undertaken against the National Occupational Standards (NOS) for operating process plant. Companies may adopt in-house schemes which the Framework requires be mapped against the NOS. Any such in-house schemes will require approval by EU Skills in their role as the competency assessment body for the Water Industry.

7 Treated or partially treated water reservoirs and tanks

Treated water storage tanks (including break pressure tanks, pump suction tanks and disinfection contact tanks) can be at risk of contamination through ingress. If contamination occurs at a treated water reservoir there may be little opportunity to rectify water quality before the water is supplied to consumers.

Water undertakers should ensure that the design and operation of treated water storage facilities minimises the risk of deterioration of water quality during its storage. Vigilance should also be applied to any tanks containing treatment chemicals or partially treated water for use in water treatment processes (for example, tanks used to store water for filter backwashing).

7.1 Measures to prevent contamination or deterioration

Tanks containing treated water for supply without further treatment and disinfection should be closed structures, designed, constructed, maintained and operated to prevent the ingress of surface water or other potential contaminants. Livestock should be excluded from the roofs of treated water storage tanks and all reasonable measures should be taken to exclude other animal access and control vermin.

Measures to prevent unauthorised access should be installed according to water industry security standards and comply with the Security and Emergencies Direction 2006 or its equivalent in Scotland and Northern Ireland. .

Tanks and their pipework should be designed to aid circulation of the stored water to prevent stagnation. The design should include arrangements for the satisfactory discharge of any occasional overflows or drainage of the stored water. Operating regimes should recognise the role of minimising the residence time of stored water in preventing deterioration in quality.

Regular external and internal inspections of the structural condition of storage tanks should be undertaken to identify any ingress of surface water through joints, seals or fittings. Inspections should be carried out by competent personnel. Condition reports should be produced at the time of inspection and recommendations to ensure integrity of structure and maintain hygiene acted upon.

The frequency of inspection (both internal and external) should be determined by individual risk assessment and be appropriate to the engineering design and condition of the structure.

Following internal inspection, the service reservoir must be cleaned and disinfected, before being returned to supply. The adequacy of disinfection (i.e.: microbiological quality) and

the aesthetic acceptability of the water within the cleaned structure should be demonstrated by sampling before it is returned to service.

Further considerations are outlined in Technical Guidance Note 9.

8 Distribution systems

8.1 General principles

Distribution systems should be designed and operated to prevent the deterioration of treated water as it travels through the network. In particular, the number of dead-ends should be minimised, and where unavoidable, flushing facilities should be provided. Additionally, they should be designed and operated to remain under positive pressure at all times.

All materials used in the construction and maintenance of distribution systems should be approved for use. For further guidance see Section 9.

Water undertakers should perform appropriate inspection and maintenance of key distribution infrastructure (e.g. air valves) using a risk based approach. Air valves should be positioned in chambers above the point to where surface water might rise, to avoid the potential for contamination entering through the valve.

All pipes and fittings for new mains should be transported and stored so as to prevent ingress or contamination. They should not be stored in direct contact with the ground and open ends should be capped or otherwise protected. Measures should be taken to exclude ingress or contamination during laying.

The pipe end should be capped whenever work stops for an extended period (e.g. overnight). Before a new main is brought into service it should be cleaned, disinfected and where appropriate, pressure tested. Samples should be taken, analysed and satisfactory results obtained in respect of microbiological and aesthetic parameters.

Where water mains are being rehabilitated, water undertakers should consider arrangements to provide a continued supply of wholesome water through enabling works or alternative supplies (including overland mains, tankers / bowsers or bottled water) whilst rehabilitation is carried out.

Where possible, mains should be repaired without full depressurisation to prevent ingress. Where depressurisation cannot be avoided, adequate dewatering facilities should be available on site.

Further considerations are outlined in Technical Guidance Notes 2, 3, 4, 5, 6, 12, 13 and 14.

8.2 Out-of-service and abandoned mains

Where mains have been taken out of service for an extended period of time prior to re-commissioning, further risk assessment should be carried out to determine whether water quality may have significantly deteriorated. Such assessment should include the requirement for further disinfection, flushing and sampling and analysis.

Abandoned mains and services should be disconnected as soon as possible from the network so that no contamination or deterioration can occur. Records should be kept to clearly identify abandoned mains and valves that are left in the ground.

Further considerations are outlined in Technical Guidance Note 5.

8.3 Contamination by backflow

Backflow of water from customers' installations or via air valves and other distribution fittings into the mains can be a source of serious contamination. Backflow can occur when network pressure drops or is low, when mains are isolated for essential work, or where high pressure installations in customers' premises overcome mains pressure.

The Water Supply (Water Fittings) Regulations (1999) and equivalents in Northern Ireland and Scotland make provision to prevent contamination due to the materials of construction or the installation and operation of water fittings. Advice and guidance is available from the Water Regulation Advisory Scheme (WRAS). Fittings must not be installed in such a

way that they are likely to cause contamination.

Water undertakers are required to enforce the requirements of these regulations and have powers to enter premises to inspect installations. Procedures should be in place to maintain a programme for inspecting installations at sites deemed to be at high risk (for example industrial plants and farms or where a site uses a blend of mains water and water taken from a private water supply).

8.4 Bottled Water

Where alternative water supplies are provided through bottled water (in emergencies or associated with planned interruptions) then a water undertaker must be able to demonstrate that the bottled water meets the relevant requirements of the Regulations.

Procedures must be in place to provide quality assurance of bottled water through the whole supply chain including storage and deployment.

Procedures for the recall of batches of bottled water must be in place if the quality of water is known to have deteriorated.

Further considerations are outlined in Technical Guidance Note 11.

9 Materials in contact with water

Water quality problems can arise from the use of inappropriate materials in contact with water. To reduce this risk, materials in contact with water intended for human consumption must meet the requirements of the Regulations (e.g. Regulation 31 of the Water Supply (Water Quality) Regulations 2016 in England or equivalent in devolved administrations).

Water undertakers should have policies and procedures to assure themselves that materials (under their control) comply with the requirements of this Regulation. The process for approval of new materials and products is controlled and managed by the Drinking Water Inspectorate. Further advice on the selection and approval of suitable materials is available on the DWI website.

10 Management of events potentially affecting human health

Water undertakers must have procedures in place to identify and respond to events affecting (or that have the potential to affect) drinking water quality. These procedures should be regularly rehearsed and updated as necessary.

Water undertakers should have clear management procedures for dealing with such events, including appropriate reporting lines and timings of internal and external notifications. As regulator for England and Wales the DWI has provided guidance on the types of event to be notified. These can be found on the DWI website.

The duty of care with respect to the protection of consumers' health is ultimately the responsibility of the water undertaker. Procedures should be in place for warning consumers as soon as practicable in the event of a restriction to water use for water quality reasons.

Water undertakers should establish and maintain regular contact with appropriately individuals from those organisations that have responsibility for the protection of human health. Any restrictions on water use that may be considered necessary should be developed in conjunction with relevant health professionals.

Following any significant event affecting drinking water quality, reviews with relevant personnel and stakeholders (including external organisations and other water undertakers) should be held to identify any necessary changes to procedures and working practices to prevent a recurrence. If the circumstances of an event dictate it, the relevant risk assessment or procedure associated with the drinking water safety plan should be reviewed and revised as necessary.

Further considerations are outlined in Technical Guidance Note 10.

11 Technical Guidance Notes

Water undertakers will have developed their own procedures and practices to take into account the Principles of Water Supply Hygiene contained within this document. However, to ensure a consistent approach across the industry, Water UK has developed additional "Technical Guidance Notes" (TGNs) to provide further detail on a range of operational activities that have a significant impact on water hygiene.

These TGNs are based on the experience of the many technical, engineering, operational and water quality staff, who have been involved in their development and routine application of such procedures from all parts of the UK. They also take account of a broad range of views from water operators to reach a consensus on what is recognised as good practice.

They are designed to help water suppliers develop their internal procedures. They are not intended to be prescriptive and in many cases alternative approaches to achieving the same objectives may be valid. This is for individual undertakers to decide. It is intended that the TGNs will be regularly revised and updated in the light of practical experience and technical and regulatory developments.

UK water suppliers have a proven tradition of providing safe and wholesome water to consumers. These TGNs will help water suppliers to maintain and develop the UK's excellent record.

The TGNs can be found on the Water UK website. The current list of TGNs at the time of publication (2010) is:

TGN 1	Medical screening
TGN 2	Distribution system (new mains and services)
TGN 3	Distribution system (repaired mains)
TGN 4	Distribution system (renovated mains)
TGN 5	Distribution system (abandoned mains and changed status mains)
TGN 6	Temporary mains
TGN 7	Catchment protection
TGN 8	Water treatment (Disinfection)
TGN 9	Storage of treated water
TGN 10	Event and incident management
TGN 11	Storage and use of bottled water
TGN 12	Tankers, bowsers and static tanks -
TGN 13	Preparation of chlorine solutions
TGN 14	Disposal of chlorinated water
TGN 15	Installation of service reservoir sample points
TGN16	Quality assurance of on-line water quality monitoring instrumentation, used for the control and monitoring of disinfection processes.