



Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive



Drinking Water and Health

**A Review and Guide
for
Population Health
Health Service Executive**

December 2008

Foreword

The safety of drinking water has a direct influence on the health of consumers. Here in Ireland the provision of safe drinking water is a complex process, involving different agencies and professional groups.

The responsibility for the provision of safe drinking water rests with the Local Authorities, Committees of Group Water Schemes and those who individually provide their own drinking water. The Health Service Executive has a key role in assessing and advising on potential risks to human health. This role is acknowledged within the framework of legislation that governs drinking water provision.

“Drinking Water and Health – A Review and Guide for Population Health, Health Service Executive, 2008” is a resource for HSE Public Health Departments and Environmental Health Service. The document is based on an original document *“Drinking Water and Public Health, 2005”*, that was designed primarily for the guidance of Public Health Physicians. This document has been revised and updated by the HSE Population Health Water Group. The primary purpose of the document is to assure increased consistency of approach from and between HSE staff of different professional backgrounds who are involved with drinking water safety. It should be used as a dynamic document which is updated as necessary and reviewed every two years or earlier as required.

In compiling this document the priorities were:

- To summarise the legislative basis
- To outline the respective roles and responsibilities of relevant agencies and professional groups
- To clarify communication and information exchange mechanisms within the HSE and between the HSE and other agencies
- To advise on risk assessment for exceedances, incidents and departures
- To advise on mechanisms for protecting human health
- To outline related areas of work including surveillance of waterborne illness, outbreaks, deliberate release and fluoridation.

“Drinking Water and Health – A Review and Guide for Population Health, Health Service Executive” is available on the HSE intranet at:

http://hsenet.hse.ie/HSE_Central/Population_Health/Health_Protection/Drinking_Water/
and
http://hsenet.hse.ie/HSE_Central/Population_Health/Environmental_Health/

HSE Drinking Water Health Advice for individual parameters is being developed and will be available on the HSE intranet Drinking Water A-Z Directory at:

http://hsenet.hse.ie/HSE_Central/Population_Health/Health_Protection/Drinking_Water/A_to_Z_Directory/

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Abbreviations

ADI	Acceptable Daily Intake
ATSDR	Agency for Toxic Substances and Disease Registry
CCMA	County and City Managers' Association
CIDR	Computerised Infectious Disease Reporting
DoHC	Department of Health and Children
DPH	Director of Public Health
DWIRP	Drinking Water Incidence Response Plan
EDEN	Environmental Data Exchange Network
EHO	Environmental Health Officer
EPA	Environmental Protection Agency
FAQs	Frequently Asked Questions
FSAI	Food Safety Authority of Ireland
GIS	Geographical Information Systems
HPSC	Health Protection Surveillance Centre - previously known as National Disease Surveillance Centre (NDSC)
HSE	Health Service Executive
IRT	Incident Response Team
MOH	Medical Officer of Health
NFGWS	National Federation of Group Water Schemes
NSAI	National Standards Authority of Ireland
OCT	Outbreak Control Team
PCR	Polymerase Chain Reaction
PEHO	Principal Environmental Health Officer
SMO	Senior Medical Officer
SPHM	Specialist in Public Health Medicine (also known as Consultant in Public Health Medicine)
TDI	Tolerable Daily Intake
WHO	World Health Organisation
WSIP	Water Services Investment Programme
WSNTG	Water Services National Training Group
XML	Extensible Markup Language

Definitions

Acceptable Daily Intake (ADI)	Estimated maximum amount of an agent, expressed on a body mass basis, to which an individual in a (sub) population may be exposed daily over its lifetime without appreciable health risk.
Aquifer	Underground water-bearing rock or gravel.
Biofilm	A surface layer of micro-organisms which may form, for example, on the inner surface of pipe work.
Bowser	A portable water tank used to supply water to an area when normal mains water distribution is unavailable.
Ground Water	That part of the subsurface water that is in the saturated zone, i.e. below the water table.
Hard Water	Water containing dissolved calcium and magnesium ions; tends to be neutral or basic.
Lowest Observed Adverse Effect Level (LOAEL)	If a NOAEL is not available, a LOAEL is defined as the lowest observed dose or concentration of a substance at which there is a detectable adverse health effect.
No Observed Adverse Effect Level (NOAEL)	The highest dose or concentration of a chemical which causes no detectable adverse health effect. Wherever possible, the NOAEL is based on long term studies, preferably of ingestion in drinking water. NOAEL is a toxicology concept used to derive ADI and define acceptable and safe limits for given constituents.
Outbreak	An outbreak of infection or foodborne illness may be defined as two or more linked cases of the same illness or the situation where the observed number of cases exceeds the expected number, or a single case of disease caused by a significant pathogen (e.g. diphtheria or viral haemorrhagic fever). Outbreaks may be confined to some of the members of one family or may be more widespread and involve cases either locally, nationally or internationally.
Soft Water	Water not containing dissolved calcium and magnesium ions; tends to be acidic.
Standpipe	A vertical pipe which allows direct access to the water main in a street etc.

Surface Water	Surface fresh water from which drinking water is abstracted, or intended to be abstracted, and supplied by a distribution network for public use.
Tolerable Daily Intake (TDI)	Analogous to ADI. The term Tolerable is used for agents which are not deliberately added such as contaminants in food.
Water Quality Exceedance	A monitoring result which exceeds the accepted value for that parameter.
Water Quality Incident	A situation where, following local risk assessment, it is considered that the quality of drinking water represents an actual or potential danger to the health of consumers and where there is need for emergency action (intra-agency or inter-agency) to intervene in the interests of public health.
Water Services Authority	Water Services or Local Authorities are those authorities that carry out statutory water services functions including provision of clean drinking water, management of waste and waste water, provision of fit housing, water fluoridation and management of pollution issues. The Water Services Act 2007 replaced the term Sanitary Authorities with Water Services Authorities. There are 34 designated WSAs - these are the city and county councils in Ireland.
Water Table	A water table is the upper level of an aquifer; the very top of the zone at which the earth and rock is saturated with water.

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Chapter 1 - Introduction

This document refers to and should be read in conjunction with:

- WHO (2006) Guidelines for Drinking Water Quality, First Addendum to 3rd Edition, Vol 1, Recommendations.
- WHO (2008) Guidelines for Drinking Water Quality, Second Addendum to 3rd Edition, Vol 1, Recommendations.
- European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007).
- EPA (2007) Drinking Water Regulations Guidance Booklet No. 1. (Guidance for Local Authorities on Regulation 9 and Regulation 10 of the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007).
- NDSC (2004) Report of the Waterborne Cryptosporidiosis Subcommittee of the Scientific Advisory Committee.
- WSNTG (2007) Drinking Water Incident Management. Guidance on Preparing and Implementing a Drinking Water Incident Response Plan.
- EPA Annual Report on the Quality of Drinking Water in Ireland.
- Hunter PR (2000) Advice on the response from public health and environmental health to the detection of cryptosporidial oocysts in treated drinking water. *Communicable Disease and Public Health*; 3: 24-27.

Water is essential to life. A person's survival depends on the availability of clean drinking water and is therefore a necessary requirement for all people. Water is used for a wide variety of activities and some of these are more important than others, for example, having a few litres of water to drink a day is more vital than washing clothes. Each additional use has health and other benefits, but with decreasing urgency (see Figure 1). Minimum international guidelines require that each person have access to at least 20 litres per day.

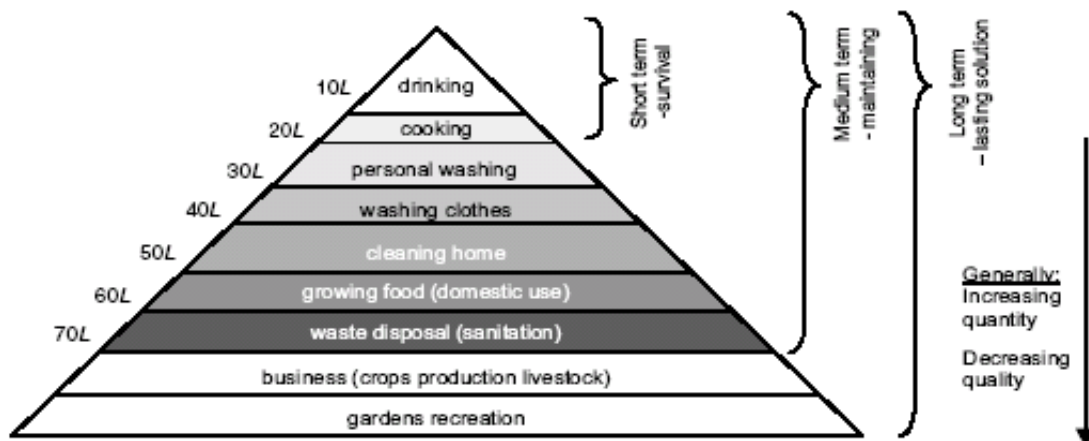


Figure 1: Hierarchy of water requirements
(after Abraham Maslow's hierarchy of needs)

(Source: WHO (2005) Minimum water quantity needed for domestic use in emergencies)

Waterborne disease accounts for a substantial proportion of notified infectious disease and for several high profile incidents in recent years. Serious illness and death was associated with *E. coli* O157 in Walkerton, Canada (2000). A large outbreak of cryptosporidiosis in Milwaukee, USA in 1993 led to worldwide awareness of infection associated with waterborne *Cryptosporidium*. *Cryptosporidium* has been associated with outbreaks in Ireland,

including Mullingar (2002), Carlow (2005), Ennis (2005), Portlaoise (2006) and Galway (2007). In Co. Meath in 2004 there were three outbreaks of VTEC infections related to drinking water from private wells. In Ireland, although only 8% (25/315) of non-viral infectious intestinal disease outbreaks between 2004 and 2007 were associated with a suspected waterborne route, these outbreaks accounted for 17% of cases of illness. Many barriers are already in place to prevent waterborne illness, but as several outbreaks have demonstrated, any breakdown in these barriers has the potential to cause large outbreaks with considerable morbidity.

In other incidents attention has focused on industrial water pollution, for example contamination with an industrial chemical in Nenagh (1996), hydrocarbons in Co. Leitrim (2004) and naturally occurring chemicals, for example uranium in Co. Wicklow (2002). In 2007 five Group Water Schemes in counties Cavan and Monaghan were contaminated with phenols, acetic acid, aromatic hydrocarbons and other compounds found in the aluminium chloride product used in the water treatment process. Public concern has emerged about the health effects of additives to drinking water, for example, fluoride. National and Regional Emergency Plans are drafted and the awareness of potential threats to water supplies from bioterrorism has increased since September 11th 2001.

In the Republic of Ireland it is estimated that the following types of water supply serve the indicated proportions of the population;

- **944 public water supplies** serve almost 82% of the population
- **777 public group water schemes** serve just over 3% ('public' group water schemes obtain their water from the Water Services Authority and distribute it themselves)
- **706 private group water schemes** serve 6% ('private' group water schemes which source and distribute their own water)
- **624 small private supplies** serve 0.3% and
- **an unknown number of exempted supplies** serve almost 9%.

[Exempted supplies are supplies that are provided from either an individual supply providing less than 10m³ a day on average or serving fewer than 50 persons and do not supply water as part of a public or commercial activity (EPA, 2007a)].

Ireland has a large proportion of low-volume water supplies compared with other EU countries, due to the policy of development of rural areas. Also, Ireland has a large proportion of water supplies from surface water sources (83% surface water, 11% ground water, 5% spring water and 1% unknown). Low-volume supplies may fail to adequately dilute contaminants and surface water supplies are particularly vulnerable.

Drinking water supply systems consist of:

- a **water source**, such as a lake, reservoir, river intake, spring catchment tank, or groundwater borehole;
- a **raw water main**, which connects the drinking water source via a pipeline or aqueduct to a water-treatment plant;
- a **treatment plant**, in which processes such as coagulation, sedimentation, filtration, active carbon treatment, ozonisation, and chlorination are carried out;
- a **piped distribution** system in which drinking water is transported to end-users or, more commonly, to water tanks or water towers elevated above the end-users;
- **water tanks and towers**, which can provide a steady supply of drinking water at a more constant pressure;
- a **local piped distribution** system in which pumped or gravity-fed water under pressure is provided to residential water tanks and taps or other end-users.

The HSE was established on January 1st 2005 and assumed the responsibilities of the former Health Boards. HSE services involved with drinking water are the Environmental Health Service, Public Health Departments, Health Protection Surveillance Centre (HPSC), microbiologists, laboratory and dental services and emergency planning structures. The table below summarises the HSE role but is not intended to be exhaustive.

The role of the HSE in relation to drinking water

Role	Basis	Responsibility
Surveillance of human illness	Infectious disease legislation - Medical Officer of Health (MOH) function	Public Health Departments (local) HPSC (national)
Identification and investigation of outbreaks	Infectious disease legislation - MOH function	Public Health Departments (local) HPSC (national) Environmental Health Service
Sampling/monitoring water quality	Service Level Agreement with Local Authorities Food safety legislation	Environmental Health Service
Laboratory services	Infectious disease legislation Food safety legislation Service Level Agreement with Local Authorities	Public Health laboratories (microbiological parameters, clinical specimens) Public Analyst laboratories (chemical analytical services)
Fluoridation of public water supplies	Fluoridation of water supplies regulations	Environmental Health Service Dental Service Public Health Physicians*
Public health medical risk assessment and advice to other health professionals, other agencies and the public	Infectious disease legislation - MOH function	Public Health Physicians Communications Department
Identification of vulnerable and risk groups	Infectious disease legislation Food safety legislation	Public Health Physicians Environmental Health Service
Environmental health risk assessment and advice		Environmental Health Service
Liaison with Local Authorities	Local protocols/guidelines Water liaison groups Incident response teams Emergency planning	Public Health Departments Environmental Health Service
Advocacy on behalf of the public's health		HSE
Response to outbreaks/incidents	Infectious disease legislation Drinking water regulations Emergency planning framework	Public Health Departments Environmental Health Service Laboratory Service Clinical microbiologists Emergency management
Emergency planning	Emergency planning framework	Public Health Departments Emergency Planning Local Health Office Environmental Health Service Hospital Network

* Public Health Physicians include Director of Public Health, Specialist/Consultant in Public Health Medicine, Senior Medical Officer and Specialist Registrar.

References

EPA Annual Report on the Quality of Drinking Water in Ireland.

EPA (2007). Drinking Water Regulations Guidance Booklet No. 1. (Guidance for Local Authorities on Regulation 9 and Regulation 10 of the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007)). Issued November 2007. EPA: Wexford.

EPA (2007a). The Provision and Quality of Drinking Water in Ireland. A report for the years 2006-2007. EPA: Wexford.

European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007). The Stationery Office: Dublin.

FSAI (2006). Safety of Potable Water in Ireland. Report to the Board of the Food Safety Authority of Ireland.

Hunter PR (2000). Advice on the response from public health and environmental health to the detection of cryptosporidial oocysts in treated drinking water. *Communicable Disease and Public Health*; **3**: 24-27.

NDSC (2004). Report of the Waterborne Cryptosporidiosis Subcommittee of the Scientific Advisory Committee.

WHO (2005). Minimum water quantity needed for domestic use in emergencies. WHO Technical Notes for Emergencies. Technical Note No. 9.

WHO (2006). Guidelines for Drinking Water Quality, First Addendum to 3rd Edition, Vol 1, Recommendations. WHO: Geneva.

WHO (2008). Guidelines for Drinking Water Quality, Second Addendum to 3rd Edition, Vol 1, Recommendations. WHO: Geneva.

WSNTG (2007). Drinking Water Incident Management. Guidance on Preparing and Implementing a Drinking Water Incident Response Plan.

Refer to Appendix 1 for relevant websites.

Chapter 2 - Legislation

Drinking Water Legislation

The **Water Services Act 2007** stresses the importance of the protection of human and public health and replaces the term Sanitary Authority with Water Services Authority. The legal framework relating to the provision of water supplies by Water Services Authorities in Ireland dates back to the mid-nineteenth century. The relevant Acts and Regulations relating to the provision of water supplies and their principal provisions are included in Appendix 2.

The European Union Drinking Water Directive (98/83/EC of 3 November 1998) set standards (levels) for the most common substances (so-called parameters) that can be found in drinking water. These standards were translated into Irish law by the European Communities (Drinking Water) (No.2) Regulations 2007 (S.I. No. 278 of 2007).

The **European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007)** prescribe the **quality standards** to be applied, and related **supervision and enforcement procedures** in relation to supplies of drinking water, including requirements as to **sampling frequency, methods of analysis, the provision of information to consumers** and related matters. Where the water quality does not meet the specified standards, remedial measures are outlined. These regulations do not change the monitoring requirements or water quality standards (except for fluoride), from previous regulations but do change the enforcement of the regulations, assigning new powers to the Environmental Protection Agency (EPA) and Local Authorities, and explicitly refer to the role of the HSE in relation to both the water supplier and the supervisory authority. **Consultation with and agreement of the HSE** are required where there are implications for public health. Failure of the water supplier to comply with specific aspects of the regulations is an **offence** and **prosecution** may be taken by the supervisory authority.

The main provisions of these regulations from HSE perspective are summarised below in terms of:

1. **Protection of human health**
2. **Supervisory authority**
3. **Definitions of ‘water for human consumption’, ‘water supplier’, ‘exempted supply’**
4. **Notification of consumers**
5. **Parameters and parametric values**
6. **Monitoring**

1. Protection of Human Health

Paragraph 9 (1) of the Regulations states “Where a sanitary authority, **in consultation with the Health Service Executive**, considers that a supply of water intended for human consumption constitutes a potential danger to human health, the authority shall, **subject to agreement with the Health Service Executive**, ensure that –

- a) the supply of such water is prohibited, or the use of such water is restricted, or such other action is taken as is necessary to protect human health
- b) consumers are informed promptly thereof and given the necessary advice, and
- c) in the case of a public water supply, the Agency (EPA) is informed promptly.”

2. Supervisory Authority

Supervisory authority is assigned to the EPA and Local Authorities. The EPA has supervisory authority over the sanitary authority where the latter is the water supplier, while the Local Authority has supervisory powers over private water supplies including group water schemes and private commercial supplies where water is supplied to the public or as part of a commercial activity. The supervisory authority may issue a **direction “subject to agreement with the HSE”** where water intended for human consumption constitutes, or may constitute, a risk to human health’ and grant a **departure** from the parametric values **“subject to the agreement with the HSE”**. Failure of the water supplier to comply with specific aspects of the regulations is an offence and prosecution may be taken by the supervisory authority. In premises where water is supplied for human consumption as part of a commercial or public activity maintenance of internal distribution systems is the responsibility of the owner of that premises.

3. Definitions

Water intended for human consumption is defined as:

- a) all water, either in its original state or after treatment, intended for drinking, cooking, food preparation, or other domestic purposes, regardless of its origin and whether it is supplied from a distribution network, from a private source or by tanker or similar means,
- b) all water used in any food production undertaking for the manufacture, processing, preservation or marketing of products or substances intended for human consumption unless the supervisory authority is satisfied that the quality of the water cannot affect the wholesomeness of the foodstuff in its finished form,
other than
 - natural mineral waters, recognised as such by the responsible authority as defined in the European Communities (Natural Mineral Waters, Spring Waters and Other Waters in Bottles or Containers) Regulations 2007 (S.I .No. 225 of 2007),
 - water supplied in bottles or containers,
 - waters which are medicinal products within the meaning of Council Directive 65/65/EEC of 26 January 1965,
 - or an exempted supply.

Water supplier means any person supplying water intended for human consumption.

Exempted supply means a supply of water which

- a) (i) constitutes an individual supply of less than 10 cubic metres a day on average or serves fewer than 50 persons, and
(ii) is not supplied as part of a commercial or public activity, or
- b) is used exclusively for purposes in respect of which the relevant supervisory authority is satisfied that the quality of the water has no influence, either directly or indirectly, on the health of the consumers concerned.

4. Notification of Consumers

Where a Water Services Authority considers that a water supply constitutes a potential danger to human health, the Water Services Authority should notify consumers promptly and provide appropriate advice. Where remedial action is taken in relation to a water supply, the water supplier shall ensure that consumers are informed of such action, save where the supervisory authority considers the non-compliance with the parametric value to be trivial in nature or extent.

5. Parameters and Parametric Values

The regulations include **48 parameters** in three categories, **microbiological, chemical and indicator** parameters. The indicator category includes some chemical and biological parameters together with other factors (colour, conductivity, odour, taste and turbidity) and two indicators of **radioactivity**.

Table A: Microbiological Parameters (Part 1, S.I. No. 278 of 2007, p21)

	Parameter	Parametric value (number/100 ml)
1	<i>Escherichia coli</i> (<i>E. coli</i>)	0
2	Enterococci	0

Table B: Chemical Parameters (Part 1, S.I. No. 278 of 2007, p21)

	Parameter	Parametric value	Unit	Comment (see S.I. No. 278 of 2007)
3	Acrylamide	0.10	µg/l	Note 1
4	Antimony	5.0	µg/l	
5	Arsenic	10	µg/l	
6	Benzene	1.0	µg/l	
7	Benzo(a)pyrene	0.010	µg/l	
8	Boron	1.0	µg/l	
9	Bromate <ul style="list-style-type: none"> ▪ until 24 Dec 2008 ▪ from 25 Dec 2008 	25 10	µg/l µg/l	
10	Cadmium	5.0	µg/l	
11	Chromium	50	µg/l	
12	Copper	2.0	mg/l	Note 2
13	Cyanide	50	µg/l	
14	1,2-dichlorethane	3.0	µg/l	
15	Epichlorohydrin	0.10	µg/l	Note 1
16	Fluoride <ul style="list-style-type: none"> (a) fluoridated supplies <ul style="list-style-type: none"> ▪ until 30 June 2007 ▪ from 1 July 2007 (b) supplies with naturally occurring fluoride, not needing further fluoridation 	1.0 0.8 1.5	mg/l mg/l mg/l	
17	Lead <ul style="list-style-type: none"> ▪ until 24 Dec 2013 ▪ from 25 Dec 2013 	25 10	µg/l µg/l	Notes 2 and 3
18	Mercury	1.0	µg/l	
19	Nickel	20	µg/l	Note 2
20	Nitrate	50	mg/l	Note 4
21	Nitrite	0.50	mg/l	Note 4
22	Pesticides	0.10	µg/l	Notes 5 and 6
23	Pesticides - Total	0.50	µg/l	Notes 5 and 7
24	Polycyclic aromatic hydrocarbons	0.10	µg/l	Sum of concentrations of specified compounds; Note 8
25	Selenium	10	µg/l	
26	Tetrachloroethene and Trichloroethene	10	µg/l	Sum of concentrations of specified parameters
27	Trihalomethanes - Total <ul style="list-style-type: none"> ▪ until 24 Dec 2008 ▪ from 25 Dec 2008 	150 100	µg/l µg/l	Sum of concentrations of specified compounds; Note 9
28	Vinyl chloride	0.50	µg/l	Note 1

Table C: Indicator Parameters (Part 1, S.I. No. 278 of 2007, p24)

	Parameter	Parametric value	Unit	Comment (see S.I. No. 278 of 2007)
29	Aluminium	200	µg/l	
30	Ammonium	0.30	mg/l	
31	Chloride	250	mg/l	Note 1
32	Clostridium perfringens	0	number/100 ml	Note 2
33	Colour	Acceptable to consumers and no abnormal change		
34	Conductivity	2,500	µS cm ⁻¹ at 20°C	Note 1
35	Hydrogen ion concentration	≥ 6.5 and ≤ 9.5	pH units	Note 1
36	Iron	200	µg/l	
37	Manganese	50	µg/l	
38	Odour	Acceptable to consumers and no abnormal change		
39	Oxidisability	5.0	mg/l O ₂	Note 3
40	Sulphate	250	mg/l	Note 1
41	Sodium	200	mg/l	
42	Taste	Acceptable to consumers and no abnormal change		
43	Colony count 22°	No abnormal change		
44	Coliform bacteria	0	number/100 ml	
45	Total organic carbon (TOC)	No abnormal change		Note 4
46	Turbidity	Acceptable to consumers and no abnormal change		Note 5

Radioactivity

	Parameter	Parametric value	Unit	Comment (see S.I. No. 278 of 2007)
47	Tritium	100	Bq/l	Notes 6 and 8
48	Total indicative dose	0.10	mSv/year	Notes 7 and 8

6. Monitoring

There are two monitoring categories, **check** monitoring and **audit** monitoring, the latter requiring fewer samples which are more demanding in terms of analysis.

Check monitoring provides information on the organoleptic (e.g. taste, odour) and microbiological quality of water and on the effectiveness of drinking water treatment. Only some parameters require monitoring in certain circumstances.

The following parameters must be subject to check monitoring:

- Aluminium (when used as flocculant)
- Ammonium
- Colour
- Conductivity
- Clostridium perfringens* (if water originates from or is influenced by surface water)
- Escherichia coli* (*E. coli*)
- Hydrogen ion concentration
- Iron (when used as flocculant)
- Nitrite (when chloramination used)
- Odour
- Taste
- Coliform bacteria
- Turbidity

Audit monitoring determines compliance with the all parameters given in Tables above. All parameters are subject to audit monitoring unless it can be established by a supervisory authority, for a period of time to be determined by it, that a parameter is unlikely to be present in concentrations that would breach the values.

The minimum monitoring frequencies are related to the volume of water distributed or produced each day within a supply zone. The number of inhabitants in a supply zone may be used instead of the volume of water to determine the minimum frequency, assuming a water consumption of 200 litres/day/capita. Where the values of the results obtained from samples taken during the preceding two years are constant and are significantly better than the parametric values, the number of samples specified in Table B of Part 2 may be reduced for supplies producing greater than 100 m³, but not by more than 50%.

Table B: Minimum frequency of sampling and analyses for water intended for human consumption supplied from a distribution network, or from a tanker, or used in a food production undertaking (Part 2, S.I. No. 278 of 2007, p27)

Volume of water distributed or produced each day within a supply zone (m ³)	Check monitoring Number of samples per year	Audit monitoring Number of samples per year
< 10 where water is supplied as part of a commercial or public activity	To be determined by supervisory authority	To be determined by supervisory authority
≥ 10 ≤ 100	2	To be determined by supervisory authority
> 100 ≤ 1,000	4	1
> 1,000 ≤ 10,000	4 +3 for each 1000 m ³ /d and part thereof of the total volume	1 +1 for each 3,300 m ³ /d and part thereof of the total volume
> 10,000 ≤ 100,000		3 +1 for each 10,000 m ³ /d and part thereof of the total volume
> 100,000		10 +1 for each 25,000 m ³ /d and part thereof of the total volume

For full notes see S.I. No. 278 of 2007.

Other Relevant Legislation

Other relevant legislation relates to **infectious diseases, food hygiene, mineral and other bottled water, and fluoridation.**

1. Infectious Disease Regulations 1981 (S.I. No. 390 of 1981)

Section XI states:-...*“on becoming aware, whether from a notification or intimation under these regulations or otherwise, of a case or a suspected case of an infectious disease or of a probable source of infection with such a disease, a Medical Officer of Health, or a Health Officer on the advice of a Medical Officer of Health, shall make such inquiries and take such steps as are necessary or desirable for investigating the nature and source of such infection and for removing conditions to such infection.”*

The Medical Officer of Health is the appropriate Director of Public Health or delegated Specialist in Public Health Medicine, and, at national level, the Assistant National Director Health Protection, HSE Population Health Directorate.

2. Food Hygiene Legislation

The HSE Environmental Health Departments are responsible for the food safety supervision of approximately 95% of the food premises in the country, which amounts to about 42,000 food businesses. Many other agencies such as the Department of Agriculture, Fisheries, and Food and the Sea-Fisheries Protection Agency supervise food premises that deal with certain categories of foods of animal origin, cereals, eggs and fish. Water is obviously used as a food and a food ingredient as well as for cleaning.

“Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28th Jan 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down the procedures in matters of food safety”

defines “food” as including “.. water after the point of compliance as defined in Article 6 of Directive 80/778/EC and without prejudice to the requirement of Directives 80/778/EEC and 98/83/EC.”

Under Regulation 178/2002 as above “Regulation (EC) No. 852/2004 of the European Parliament and of the Council of 29th April 2004 on the hygiene of foodstuffs” was enacted and is enshrined in Irish legislation through such statutory instruments as the EC (Hygiene of Foodstuffs) Regulations 2006 (S.I. No. 369 of 2006) and European Communities (General Food Law) Regulations 2007 (S.I. No. 747 of 2007). Annex II Chapter VII of 852/2004 above deals with “Water Supply” and Paragraph 1 (a) says that “there is to be an adequate supply of potable water supply, which is to be used whenever necessary to ensure that foodstuffs are not contaminated”.

The HSE therefore has a **supervising responsibility for water supplied to food premises** under their control from a food safety perspective. This power exists independent of those outlined in the Drinking Water Regulations. In dealing with problems encountered with drinking water in a food premises regard must be given to whether the problems arise as a result of the internal plumbing and storage of the water or whether the quality is unsuitable when first delivered into the premises from the mains. The vast majority of food premises are on public water supplies but in rural areas of the country many are on group water schemes and a lesser number are on private supplies. In many instances food premises must provide their own in-house treatment either from the perspective of the need to assure a particular standard for a specialised food manufacturing purpose or simply to bring an unsatisfactory incoming supply up to a standard where it complies with the Drinking Water Regulations. Environmental Health Officers (EHOs) encourage food business operators to include the monitoring of water quality as part of their Hazard Analysis Critical Control Point food safety management system.

3. Mineral Water and Other Bottled Water

The EU legislation which relates to mineral water include Council Directive 80/777/EEC, Directive 96/70/EC and Commission Directive 2003/40/EC. In Ireland, the European Communities (Natural Mineral Waters, Spring Waters and Other Waters in Bottles or Containers) Regulations 2007 (S.I. No. 225 of 2007) and the European Communities (Natural Mineral Waters, Spring Waters and Other Waters in Bottles or Containers) (Amendment) Regulations 2007 (S.I. No. 686 of 2007) specifies three types of water which can be bottled or packaged: **natural mineral water, spring water and all other water.**

Natural mineral water is microbiologically wholesome water, originating in an underground source, protected from all risk of pollution and emerging from a spring tapped at one or more natural or bore exits. It is clearly distinguished from ordinary drinking water by its nature (mineral content and trace elements) and by its original state. Only very limited treatments are permitted including, for example, natural or ozone removal of constituents such as iron and manganese. Disinfection is prohibited. For a water to be declared a mineral water it must comply with Council Directive 80/777/EEC, which defines natural mineral water, its exploitation, treatment, microbiological criteria, chemical contaminants, sales descriptions, labelling and packaging. The European Commission Directive 2003/40/EC establishes the list, concentration limits and labelling requirements for the constituents of natural mineral waters and the conditions for using ozone-enriched air for the treatment of natural mineral waters and spring waters.

To be recognised as a natural mineral water, the water and source must be assessed. In Ireland, the responsible authority for assessing and declaring a water to be a natural mineral water is the National Standards Authority of Ireland (NSAI). The NSAI has an agency arrangement with the FSAI. Currently there are three waters recognised as natural mineral waters (Glenpatrick, Kerry Spring and Tipperary).

Spring water is water which is intended for consumption in its natural state, comes from an underground source, is protected from all risk of pollution and is bottled at source. Only very limited treatments are permitted. Water which does not meet the requirements of a natural mineral water but is a spring water must comply with the microbiological criteria for natural mineral waters and with limit values set for various parameters set out in the European Communities (Natural Mineral Waters, Spring Waters and Other Waters in Bottles or Containers) Regulations 2007 (S.I. No. 225 of 2007).

All other water which is intended for human consumption and is not a natural mineral water or a spring water and is placed on the market in either bottles or containers must be free from any micro-organism and parasites and from any substances which in quantity, constitute a potential danger to human health. 'Other Waters' must meet the minimum requirements set out in the regulations.

There are no restrictions on the importation of bottled water from outside the EU, other than the bottled water must meet the legal requirements described above and must be labelled in accordance with EU legislation, including where appropriate those contained in Directive 2000/13/EC. Health certificates are not required.

4. Fluoridation Legislation

In accordance with the Health (Fluoridation of Water Supplies) Act 1960 a Health Authority must arrange for the fluoridation of water supplied to the public by the Water Services Authorities. Under the fluoridation legislation monthly monitoring of fluoridated public water supplies is carried out by the Health Service Executive (see Chapter 10). Following the recommendations of the Forum on Fluoridation (2002) the Fluoridation of Water Supplies Regulations 2007 (S.I. No. 42 of 2007) specifies the amount of fluoride in drinking water in Ireland. Under Article 6 it says “The amount of fluoride which may be added to public water supplies shall be such that the water, after the addition of fluoride, shall contain **not more than 0.8 milligrams of fluoride per litre (mg/l)** of water, and **not less than 0.6 milligrams of fluoride per litre (mg/l)** of water. This brought about a reduction from the previous 0.8 – 1.0 mg/l as pertained previously.

References

Commission Directive 2003/40/EC of 16 May 2003 establishing the list, concentration limits and labelling requirements for the constituents of natural mineral waters and the conditions for using ozone-enriched air for the treatment of natural mineral waters and spring waters. (Official Journal L 126, 22.05.2003, p. 0034-0039).

Council Directive 80/777/EEC of 15 July 1980 on the approximation of the laws of the Member States relating to the exploitation and marketing of natural mineral waters. (Official Journal L 229, 30.08.1980, p.001-0010).

Council Directive 80/778/EEC of 15 July 1980 relating to the quality of water intended for human consumption (Official Journal L 229, 30.08.1980, p.0011-0029).

Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption. (Official Journal L 330, 05.12.1998, p.0032-0054).

Directive 96/70/EC of the European Parliament and of the Council of 28 October 1996 amending Council Directive 80/777/EEC on the approximation of the laws of the Member States relating to the exploitation and marketing of natural mineral waters. (Official Journal L 299, 23.11.1996, p.0026-0028).

Directive 2000/13/EC of the European Parliament and of the Council of 20 March 2000 on the approximation of the laws of the Member States relating to the labelling, presentation and advertising of foodstuffs. (Official Journal L 109, 6.5.2000, p. 0029-0042).

European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007). The Stationery Office: Dublin.

European Communities (General Food Law) Regulations 2007 (S.I. No. 747 of 2007). The Stationery Office: Dublin.

European Communities (Hygiene of Foodstuffs) Regulations 2006 (S.I. No. 369 of 2006). The Stationery Office: Dublin.

European Communities (Natural Mineral Waters, Spring Waters and Other Waters in Bottles or Containers) Regulations 2007 (S.I. No. 225 of 2007). The Stationery Office: Dublin.

European Communities (Natural Mineral Waters, Spring Waters and Other Waters in Bottles or Containers) (Amendment) Regulations 2007 (S.I. No. 686 of 2007). The Stationery Office: Dublin.

Fluoridation of Water Supplies Regulations 2007 (S.I. No. 42 of 2007). The Stationery Office: Dublin.

Forum on Fluoridation (2002). The Stationery Office: Dublin.

Health (Fluoridation of Water Supplies) Act, 1960. No. 46 of 1960. The Stationery Office: Dublin.

Infectious Disease Regulations 1981 (S.I. No. 390 of 1981). The Stationery Office: Dublin.

Regulation (EC) No. 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. Official Journal of the European Communities, L31, 1.2.2002.

Regulation (EC) No. 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs. Official Journal of the European Communities, L226, 25.6.2004.

Water Services Act 2007. The Stationery Office: Dublin.

Chapter 3 - Roles and Responsibilities

The responsibility for the provision of safe drinking water rests with the Local Authorities, Committees of Group Water Schemes and those who individually provide their own drinking water. Other bodies/agencies that are involved include the Department of the Environment, Heritage and Local Government, the EPA and the HSE. Respective roles and responsibilities are described below.

1. **Water Services/Local Authorities (previously known as Sanitary Authorities)**
2. **Group Water Schemes**
3. **Department of the Environment, Heritage and Local Government**
4. **Environmental Protection Agency (EPA)**
5. **Health Service Executive (HSE)**

1. **Water Services/Local Authorities (previously known as Sanitary Authorities)**

Water Services Authorities (29 County Councils, 5 City Councils) are responsible for the quality of drinking water that they supply to consumers. This water must comply with the Drinking Water Regulations. Where a supply is found to be in breach of the regulations they must notify the EPA of the exceedance and take whatever action is necessary to inform and protect the health of consumers if the exceedance could result in a public health risk. In determining whether there is a risk to public health Water Services Authorities are obliged under the Drinking Water Regulations to **consult with the HSE** and are required to take appropriate action **“in consultation with”** and **“subject to agreement with the HSE”**.

While the EPA has supervisory authority over the Water Services Authorities concerning the quality of the drinking water they are providing, the Water Services Authorities, on the other hand, have direct supervisory authority over the providers of other water supplies, such as group schemes and indeed even private supplies. The supervisory authority may issue a direction **“subject to agreement with the HSE”** and grant a departure from the parametric values **“subject to the agreement of the HSE”**.

In fulfilling their duties a Water Services Authority must ensure that the water supplies that come under the regulations are monitored at a frequency as set out in the Drinking Water Regulations. This monitoring service is often provided through the Environmental Health Service and the HSE laboratories while in other instances this is carried out directly by the Water Services Authorities using their own or private laboratories. In some instances a combination of monitoring procedures are in place even within the same geographic area. The Water Services Authority return check and audit monitoring results to the EPA but are not required to submit results of any additional sampling which may be operational, investigative or specified in a Direction, unless the result exceeds the parametric value. This requirement to notify the EPA applies to all exceedances regardless of whether the sample taken is a regular compliance sample or an operational/investigative sample. For any results which exceed the parametric value the Water Services Authority must consult with the HSE.

Water Services Authorities are obliged to comply with directions from the EPA and must develop **“action plans”** for ensuring a remedy to exceedances of the regulations. Water Services Authorities must also ensure that a Major Emergency Management System is in place to deal with serious breaches of the regulations. Clearly the HSE must be an integral

part of this response through the Water Liaison Committees/Incident Response Teams that should be established in each area for the management of serious water incidents.

The Water Services Authorities ensure provision of new capital schemes and upgrading works through the Water Services Investment Programme (WSIP) and compliance of drinking water with national and EU Drinking Water Standards is a major objective of WSIP. Substantial increases in water treatment and storage capacity are key objectives in this area.

The Rural Water Programme is administered solely by the Local Authorities and is comprised of a number of measures to address water quality issues and in particular deficiencies in group water schemes, small public water and sewerage systems in rural villages, and private individual supplies where an alternative group or public supply is not available.

A Geographical Information System (GIS) database of water supply catchments and distribution systems has been mapped by some Water Services Authorities.

County and City Managers' Association (CCMA)

The association consists of all County and City Managers and assistant Managers who meet on a regular basis. Issues of national, regional and local importance are discussed particularly from a policy aspect.

The work of the CCMA itself is carried out through a series of sub-committees, each involved in a specific aspect of the work of Local Authorities. At present there are subcommittees for:

1. Community Social and Economic Development
2. The Environment
3. Local Government Finance
4. Housing
5. Water Services
6. Land Use and Transport

Local Government Management Services Board

The Local Government Management Services Board, based in Dublin, provides a range of Management Services to its clients the Local Authorities. In addition it offers comprehensive advice and support on Human Resources and Industrial Relations issues. The Board seeks to support a diverse range of skills and knowledge required by the modern manager. In doing so it focuses on training and education, research and development, public relations and law.

The Office for Local Authority Management (OLAM) is a division of the Local Government Management Services Board. It was established in 2004, at the initiative of the County CCMA, with the support of the Department of the Environment, Heritage and Local Government. OLAM is the headquarters of the CCMA and provides support to the committees of that Association.

2. Group Water Schemes

Water services in much of rural Ireland are provided by community-owned and community-run group water schemes. These range from schemes with two houses to the largest with approximately 1,600 households. Within this sector, there are two categories of group schemes: those that are **privately-sourced** and those that are **publicly-sourced**.

The former, incorporating some 70,000 households, take full responsibility for the abstraction, treatment and distribution of the water supply, as well as for recovering costs from their consumers. By contrast, publicly-sourced schemes (incorporating 80,000 households) receive treated water from their Local Authority at a bulk meter, but take responsibility for distributing this to their members and for recovering costs from non-domestic consumers.

Whether privately or publicly sourced, group schemes are administered by voluntary committees and it is important to remember this in dealing with them. While most were originally organised as trusteeships, the tendency in recent years has been for schemes to reorganise as Co-operative Societies. Whatever their legal structure, schemes have difficulty in recruiting new committee members. For some, this may pose a risk in terms of communicating sampling results and “boil notices” when required, as there may be no local network for communication in place with the final consumer.

Nonetheless, where committees exist the committees/trustees are responsible for the quality and safety of the drinking water under the supervisory authority of the Water Services Authority. In the absence of an organising committee, some Water Services Authorities have had to take direct responsibility for a number of schemes by default.

The **National Federation of Group Water Schemes (NFGWS)** is the representative and negotiating organisation for the group water scheme sector in Ireland. A crucial role of the NFGWS is to assist group water schemes in meeting the standards set out in the Drinking Water Regulations, providing training and developmental support.

The framework for achieving compliance with water quality standards was established by the National Rural Water Monitoring Committee’s Action Plan for Rural Drinking Water Quality 2003-2006. As part of its remit and to improve the standard of drinking water supplies, the NFGWS has introduced a Quality Assurance System for group schemes.

As of March 2007, the Local Authority has been designated as the supervisory authority over private water supplies, including group water schemes. Guidelines in relation to compliance with the provisions of the Drinking Water Regulations 2007 will be issued by each Local Authority to the relevant Group Water Schemes in its area. These guidelines are being finalised by the Department of Environment, Heritage and Local Government in consultation with the EPA, the Local Authorities and the NFGWS.

3. Department of the Environment, Heritage and Local Government

The Department of the Environment, Heritage and Local Government is responsible for policy and legislation in relation to water quality and, with Local Authorities, is responsible for the implementation of EU Directives relating to:

- bathing waters
- dangerous substances
- freshwater fish
- shellfish waters
- groundwaters
- drinking water
- urban waste water treatment
- nitrates
- framework for community action in the field of water policy
- management of bathing water quality.

The Department funds the work of the Water Services/Local Authorities and the EPA. A centralised access database is under construction for drinking water results.

The Department has categorised the water supplies listed in the **EPA Remedial Action List** into 4 groups:

- **Category 1** - those where the source has already been abandoned, works have already been carried out that have adequately addressed the cause of the problem or where operational/management improvements will be sufficient to address the issue
- **Category 2** - those where small schemes funding will be sufficient to address the issue (in this regard schemes requiring additional turbidity monitors, residual chlorine monitors, dial-outs etc)
- **Category 3** - schemes requiring major capital investment and a scheme is already included in WSIP 2008 – 2010 to address the issue (the question of whether advance works to address some issues immediately rather than await a new scheme which may be some years away may arise)
- **Category 4** - schemes requiring major capital investment but a scheme is not included in WSIP 2008-2010 to address the issue (the question of advance works to address the immediate issue may arise in these cases).

Further details of the EPA Remedial Action List are given in the next section.

The **Water Services National Training Group (WSNTG)** organises training relevant to drinking water in five regional centres and has developed a training programme for Water Services Authorities in preparing and implementing a **Drinking Water Incident Response Plan**.

4. Environmental Protection Agency (EPA)

The EPA has responsibility for:

- approving monitoring programmes submitted by Water Services Authorities
- ensuring that Water Services Authorities are taking the appropriate action to ensure that public water supplies comply with the relevant quality standards
- requiring Water Services Authority to prepare an action programme to ensure failure to meet a standard does not recur and to carry out remedial action
- auditing of public water supplies
- provision of guidance on drinking water treatment and management.

The EPA has a wider role in relation to source protection, licensing of Local Authority waste water discharges and waste/industrial integrated pollution control licensing.

The EPA may grant a **departure** from the parametric values “**subject to the agreement with the HSE**” and may issue a **direction** “**subject to agreement with the HSE**” where water intended for human consumption constitutes, or may constitute, a risk to human health. It is an offence for a Water Services Authority not to comply with a direction. The EPA provides guidance in relation to water monitoring by Water Services Authorities and produces an annual report on Drinking Water Quality with an assessment of the results.

A handbook was published by the EPA providing guidance to Water Services Authorities for the implementation of the 2000 Drinking Water Regulations (EPA, 2004). This handbook has been supplemented by a series of four guidance booklets, pending publication of the new handbook.

- **Booklet No 1. Guidance for Local Authorities on Regulation 9 and Regulation 10 of the European Communities (Drinking Water) (No. 2) Regulations 2007 (SI No. 278 of 2007)**
- **Booklet No 2. Annual reporting of drinking water monitoring results**
- **Booklet No 3. Guidance for local authorities on the development of a remedial action list for public water supplies**
- **Booklet No 4. Risk screening methodology for *Cryptosporidium***

The handbook and booklets are available at www.epa.ie. There is also a web resource for *Cryptosporidium* at www.enforcementnetwork.ie.

In Booklet No 1 the EPA advises that the guidelines contained in the booklet and handbook should, in turn be applied by each Local Authority in the course of its own supervision of all other water supplies over which they have supervisory authority.

The EPA annual report (2007) ‘**The Provision and Quality of Drinking Water in Ireland, a report for the years 2006-2007**’ was the seventeenth drinking water report but the first report since the EPA was assigned supervisory and enforcement powers and responsibilities. In addition to presenting monitoring results by county it describes enforcement actions taken and identifies 339 supplies which need detailed profiling to determine whether the supply needs to be upgraded, improved in respect of operational practices or discontinued. The result of this profiling was published as the Remedial Action List for Public Drinking Water Supplies (EPA Booklet No 3) and the list is available at www.epa.ie. The EPA states that the **Remedial Action List** will be used to focus attention on resolving any deficiencies and will be updated on an ongoing basis to include any supply where an action programme or remedial work is

required. The HSE has a role in advising the EPA whether any further supplies should be added to the Remedial Action List. The EPA requires Water Services Authorities to prepare and implement an action programme for identifying the appropriate solution for each supply on the list.

Three types of action programme are identified:

- to abandon or replace source
- to upgrade treatment facilities
- to improve operational and maintenance arrangements.

Nominated EPA inspectors have responsibility for each Local Authority area and there is an ongoing audit programme of treatment plants.

Environmental Data Exchange Network (EDEN) will facilitate the easy exchange of drinking water sample analysis results between Local Authorities and the EPA. EDEN can be accessed through www.edenireland.ie. EDEN uses an XML data exchange template to standardise the information being exchanged. Any laboratory can exchange data with EDEN provided they follow the rules and codes set out in this template.

5. Health Service Executive (HSE)

The Director of Population Health is the HSE lead on **public health aspects of drinking water**. Two of the six Assistant Directors have primary responsibility for operational issues in relation to drinking water:

- Assistant National Director for **Health Protection** through MOH/Regional **Departments of Public Health** and the **Health Protection Surveillance Centre (HPSC)**,
- Assistant National Director for **Environmental Health** through **Environmental Health Departments**.

The Environmental Health Service and Public Health Departments have important complementary roles in relation to drinking water. A team approach, with sharing of information and development of protocols/guidelines, is crucial to fulfil legislative requirements for HSE.

Environmental Health Service

There are 32 Environmental Health Departments (each headed by a Principal Environmental Health Officer (PEHO)) and each of the four HSE Regions has an Area Chief EHO who reports to the Assistant National Director of Environmental Health. Some EHOs work directly or exclusively, or through a Service Level Agreement, with Water Services/Local Authorities while others do not. The monitoring of drinking water supplies similarly varies with some Environmental Health Departments being responsible for the entire Water Services Authority water monitoring programme while other Environmental Health Departments are only involved in the monitoring of water supplies through their functions under food safety legislation.

EHOs often have a high familiarity with individual water supplies including holding historical details of the water quality over many years. They also often have a great deal of information on catchment areas, treatment and challenges faced by individual supplies. They frequently have daily contact with Water Services Authority engineering and other technical staff.

The EHO is normally the **first point of contact between the HSE and the Water Services Authorities**. There is a need to build up a consistent approach regarding communications from, and to, the Water Services Authorities and the HSE. However, this approach must be cognisant of the variety of arrangements that exist in different parts of the country so as to protect existing good working relationships and foster better relationships where such need to occur.

The Environmental Health Service has a direct verification role concerning the water quality in food premises independent of drinking water legislation. Clarification concerning the exchange and sharing of vital information gained through food safety monitoring of private drinking water supplies is required.

Through Environmental Health Departments and the HSE laboratories private sampling and testing of drinking water quality for individuals and householders is frequently offered. In this situation Environmental Health Departments often provide direct advice to householders regarding the suitability of the usage of their water supply as a drinking water.

Public Health Departments

Through the responsibility vested in the role of the MOH, the eight regional Departments of Public Health have a pivotal role in the prevention and surveillance of waterborne disease and in the acute response to incidents that threaten public health. The Director of Public Health (DPH) heads the Public Health Department and is the designated MOH for the region. The MOH function may be delegated to a Specialist in Public Health Medicine (SPHM). Each Public Health Department works with several Environmental Health Departments and Water Services Authorities. Public Health Physicians fulfil their role in three recognised areas: risk assessment, risk management and risk communication. Other staff grades working in Departments of Public Health are Senior Medical Officers (SMOs), Surveillance Scientists and Communicable Disease Control Nurses.

The work of Public Health Departments includes:

- Ongoing surveillance of communicable disease (there is no system currently in place for monitoring environmental illness due to chemicals other than complaints)
- Enhanced surveillance of specific illnesses and in the event of an outbreak
- Identification and epidemiological investigation of an outbreak of waterborne illness
- Assessment of risk to public and identification of vulnerable groups
- Provision of public health medical advice to other health professionals, other agencies and the public
- Membership of water liaison committees (local and/or regional)
- Routine intra and interagency liaison on drinking water issues
- Accessing evidence and additional expertise where necessary from a variety of sources including literature reviews and published guidelines (WHO Guidelines on Drinking Water Quality, ATSDR etc). Health Protection in the Population Health Directorate is contracted to the Centre for Radiation, Chemical and Environmental Hazards of the UK Health Protection Agency for advice in relation to chemicals. The portal of entry for advice within working hours is through the Chemical Hazards and Poisons Division (Cardiff). Other sources of advice include the Food Safety Authority of Ireland (FSAI) toxicologist, National Poisons Information Unit, Public Health Laboratory, Microbiologist and HPSC

- Emergency planning – The DPH is a member of the HSE Crisis Management Team and Area Emergency Management Group. The DPH or SPHM is a member of the regional interagency Emergency Planning Steering and Working Groups and contributes to the External Emergency Planning Process for Seveso sites
- Media response when issues involving possible risk to public health have been identified to HSE Communications Department
- Involvement in HSE Serious Incident Management response on relevant issues.

A water incident training pack for Public Health Departments is being developed and will be available on the HSE intranet drinking water website at:

http://hsenet.hse.ie/HSE_Central/Population_Health/Health_Protection/Drinking_Water/A_to_Z_Directory/

References

EPA (2004). European Communities (Drinking Water) Regulations, 2000 (S.I. 439 of 2000). A Handbook on Implementation for Sanitary Authorities. EPA:Wexford.

EPA (2007). The Provision and Quality of Drinking Water in Ireland. A report for the years 2006-2007. EPA: Wexford.

EPA (2007). Drinking Water Regulations Guidance Booklet No. 1. Guidance for Local Authorities on Regulation 9 and Regulation 10 of the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007). Issued November 2007. EPA: Wexford.

EPA (2008). Drinking Water Regulations Guidance Booklet No. 2. Annual reporting of drinking water monitoring results. Issued January 2008. EPA: Wexford.

EPA (2008). Drinking Water Regulations Guidance Booklet No. 3. Guidance for local authorities on the development of a Remedial Action List for public water supplies. Issued February 2008. EPA: Wexford.

EPA (2008). Drinking Water Regulations Guidance Booklet No. 4. Risk screening methodology for *Cryptosporidium*. Issued January 2008. EPA: Wexford.

Chapter 4 - Communication and Information Exchange

The range of agencies involved in the safe provision of drinking water provides a challenge in ensuring appropriate and timely information exchange at both national and local level. In addition to formal exchange there is frequent informal exchange at all levels.

The sharing of relevant information between professional colleagues within HSE and with key agencies involved in the provision of safe drinking water plays a significant role in the protection of human health. The 'need to know' principle should be observed in relation to patients/cases and to clients/customers. Relevant patient information should only be shared on a confidential basis between professional colleagues.

At **national** level various committees facilitate implementation of the 2007 Drinking Water Regulations:

- **Department of Environment, Heritage and Local Government European Communities (Drinking Water) (No.2) Regulations 2007 Implementation Group.** Chair: DoEHLG
- **EPA/HSE/CCMA/DoEHLG.** Chair: EPA
- **EPA Environmental Enforcement Network Steering Committee.** Chair: EPA
- **HSE/EPA quarterly meetings** – to discuss drinking water and other issues.
Chair: EPA
- **HSE Population Health Water Group**
- In 2007 the EPA convened the **Environmental Enforcement Network Cryptosporidium Working Group**, the output/advice from which is available at www.enforcementnetwork.ie

At **local** level the relevant links for HSE are between:

1. **HSE and Local Authorities**
2. **HSE and EPA**
3. **Internal HSE Communication**

1. HSE and Local Authorities

Communications and exchange of information between HSE and Local Authorities are facilitated by a joint document/guidelines and regular meetings/updates. Historically local arrangements have varied and in some areas there has been no routine exchange of information. It is important that the Water Services Authority and the HSE communicate early to alert each other of actual or potential drinking water quality problems, or of cases of disease occurring at abnormal levels in the community. When an incident/outbreak occurs an Incident Response Team (IRT) will be convened.

i) Joint document/guidelines

The EPA Booklet No. 1 states that each Local Authority should have in place documented procedures for consultation with the HSE when a non-compliance is detected, including contact details, information to be supplied and details of agreed actions to be taken in the event of specific failures (e.g. crypto, *E. coli*, boil notices). The Local Authority *Drinking Water Incident Response Plan* includes/will include the joint HSE/Local Authority document/guidelines as Appendix A5.1.

A template for these guidelines is being developed by the HSE Population Health Water Group and will be available on the HSE intranet drinking water website, as a guide for those areas where there is no existing joint document.

ii) Joint Meetings

Regular Water Quality Liaison meetings were recommended by both the 1992 circular (Department of the Environment, 1992) and the Report on Waterborne Cryptosporidiosis (NDSC, 2004), with meetings at least twice a year. Membership of the Water Quality Liaison Group generally comprises Water Services and HSE staff and may include Engineers, Public Health Physician, EHO and Dentist. Topics for consideration include water quality results, waterborne disease trends, fluoridation and local guidelines. A template for summary *Cryptosporidium* data which may be provided by the HSE is available on the HSE intranet drinking water website. In some areas fluoridation is considered by a separate committee. Liaison groups should generally review sample results that show exceedances since their last meeting. They can also routinely examine various water supplies to note which schemes need improvement and progress on such improvements. These meetings also provide the opportunity to update contact details.

In addition to the Water Quality Liaison Group some areas also have Operational Group meetings regarding water quality. This is more likely to be in existence where the HSE undertake the sampling schedules on behalf of the Local Authorities. Operational groups, as the name suggests, deal with the day to day issues of frequency of sampling, communication of sample results, and general regular interaction between the HSE and the Local Authorities. Operational groups typically only have Environmental Health staff from the HSE side along with various representatives of the Local Authority.

iii) Local Communication and Information Exchange

The HSE informs Local Authorities of an exceedance where sampling is carried out by the HSE, and also of an increase in notifications of illness which may be linked to a water supply. The Local Authority informs and consults with the HSE where there is an exceedance or significant event (e.g. failure of water treatment or pollution incident).

Each Local Authority is obliged to have in place a staff member who will take overall responsibility for communication regarding drinking water with external organisations such as the EPA and the HSE. This nominated water liaison person should be the first point of contact regarding any issues that need attention. The usual first point of contact in the HSE is the Principal Environmental Health Officer.

Where a supply is found to be in breach of the regulations the Local Authority must complete **Appendix A, EPA Booklet No. 1**, and submit to the EPA before 11am the following day. In determining whether there is a risk to public health Water Services Authorities must **consult with the HSE** and are required to take appropriate action “**in consultation with**” and “**subject to agreement with the HSE**”. It is not always possible or appropriate to assess risk to public health in the specified timeframe, but in all cases the EPA requires details on the consultation to be completed on the notification form.

Early HSE response and advice can be categorised as:

- follow-up already specified in EPA Booklet No. 1 (for *E. coli*, coliforms, lead, copper and nickel)
- repeat sample and/or further investigations required
- the timeframe does not allow for full risk assessment of risk to public health
- specific advice for informing public about restriction of use.

A copy of Appendix A, EPA Booklet No. 1, should be sent to the PEHO by the Local Authority.

A Water Services Authority may apply to the EPA for a **departure** from the chemical parametric values. A departure may be granted by the EPA, **subject to the agreement of the HSE**, in relation to a water supply provided:

- no such departure constitutes a potential danger to public health
- the supply of water intended for human consumption in the area concerned cannot otherwise be maintained by any other reasonable means.

If the EPA grants a departure, it will be up to a maximum value for the parameter, for a period of not more than three years initially. The water supplier will be required to carry out the steps specified in the departure to the specified timetable and carry out the specified monitoring programme. If the Water Services Authority cannot complete the steps within the specified time, the EPA may grant a second departure and, in exceptional circumstances, a third departure, both subject to the agreement of the HSE. At the time of writing, the HSE has received applications for departures in relation to nitrates only (prior to the 2007 Drinking Water Regulations). A simplified procedure exists for considering applications for departures where the EPA considers that non-compliance with the parametric value is trivial, and that the problem can be remedied within 30 days (SI. No. 278 of 2007).

Principles for HSE risk assessment and response in relation to exceedances and applications for departures are set out in Chapter 5.

iv) Interagency Incident Response Team (IRT)

Most exceedances are managed entirely within the framework of the Water Services Authority either by adjustment of disinfection or by flushing/scouring the pipework. A minority of exceedances become an incident which requires an interagency IRT.

The process of convening an interagency IRT may be initiated by either the Water Services Authority or the HSE. An interagency IRT is convened in the event of a significant exceedance or incident which poses a risk to public health, or human illness which may be related to a water supply. The interagency IRT is normally chaired by the Local Authority. Each agency may also have an internal IRT or, for the HSE, an Outbreak Control Team (OCT).

The interagency IRT deals with the overall management of water incidents in terms of finding the source of contamination, preventing the distribution of contaminated water to the public and, where necessary, providing an alternative water supply. If there is imminent and significant risk to public health then early risk control measures may be necessary before the IRT is formed. The results from sample analysis might not be available in time to undertake

an informed initial risk assessment. In such circumstances the assessment of risk will have to be taken on the basis of the best information available.

The Water Services Authority members of the IRT may include engineers, service managers, laboratory and environmental staff. The membership from HSE will normally include:

- MOH - DPH/SPHM
- PEHO
- Others as appropriate e.g. SMO, surveillance scientist, microbiologist, technical services staff, communications personnel.

Tasks for the IRT – responsibility for individual tasks will vary and should be agreed at the outset.

- Maintain an incident log and include dates, times, key information and actions taken;
- Consider an onsite inspection at the location of the incident;
- Collate information on the:
 - size of the water supply
 - number of people exposed
 - number of persons ill;
- Ensure advance warning is given to relevant laboratories, as increased sampling may be likely;
- Identify food establishments and plan to deal with queries from same;
- Identify vulnerable groups;
- Agree content and distribution for communication with media and public;
- Establish helpline if necessary;
- Ensure relevant national agencies are notified as appropriate (HPSC, DoHC, EPA, FSAI);
- Prepare a report on the incident.
The following should be included:
 - Cause of the incident, type of water supply and treatment, population at risk;
 - Investigation of the waterborne hazard, laboratory results and other influences such as weather;
 - Management of the incident, including risk assessment and communication;
 - Scope for preventing a recurrence of the hazard or incident;
 - Conclusions and lessons learned;
 - Recommendations.

The EPA has asked to be consulted prior to finalising the report if the EPA is not represented on the IRT.

In the unlikely event of lack of agreement between the Local Authority and HSE in relation to issuing a restriction of use notice, including boil advisory, the HSE may issue independent advice.

2. HSE and EPA

Requirements in the legislation are set out for the EPA to **consult with and obtain agreement of the HSE** in relation to **departures** and **directions** where there is potential public health effect.

Information from the EPA is sent to the Assistant National Directors Health Protection and Environmental Health and forwarded to the appropriate PEHO and DPH/MOH. HSE response to a draft direction is provided within 5 working days.

In addition:

- a **Memorandum of Understanding** has been agreed between HSE and EPA (see HSE intranet).
- **Quarterly meetings** are held between HSE Assistant National Directors and EPA to discuss a range of topics, including drinking water.

3. Internal HSE Communication

Each Public Health Department has a working relationship with several Environmental Health Departments. A resource for sharing and obtaining information has been set up on the HSE intranet. Expertise may be accessed also through existing networks of PEHO and SPHM. A team approach is essential to fulfil the HSE role. Ongoing development of protocols/guidelines and sharing of information is key to the provision of appropriate health advice - this can be facilitated by shared training arrangements.

Environmental Health Service contacts Public Health Department:

- To discuss significant exceedances. Consultation with the MOH for every exceedance is not practical or necessary, particularly because small exceedances may be within normal parameters on resampling
- To obtain Public Health medical advice
- To discuss and agree response to an application for departure
- To discuss HSE opinion and agree response re direction
- To discuss significant complaints from public.

Public Health Department contacts Environmental Health Service:

- To obtain local information on water supply e.g. where enhanced surveillance is undertaken for VTEC or cryptosporidiosis
- To arrange sampling of private water supply
- To inform re increase in illness which may be attributed to water supply
- To discuss and agree response to an application for departure
- To discuss HSE opinion and agree response re direction
- To discuss significant complaints from public.

References

EPA (2007). Drinking Water Regulations Guidance Booklet No. 1. Guidance for Local Authorities on Regulation 9 and Regulation 10 of the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007). Issued November 2007. EPA: Wexford.

EPA and HSE (2006). Memorandum of Understanding. The Health Service Executive and the Environmental Protection Agency.

WSNTG (2007). Drinking Water Incident Management. Guidance on Preparing and Implementing a Drinking Water Incident Response Plan.

Chapter 5 - Risk Assessment for Exceedances, Incidents and Departures

Introduction

Water suppliers must ensure that water is wholesome and clean and meets the requirements of the Drinking Water Regulations. Adopting a multi-barrier, source-to-tap approach to safe drinking water will minimise the presence of contaminants. This approach includes the protection of source water, the use of appropriate and effective treatment methods, well-maintained distribution systems, and routine verification of drinking water safety (Fairley *et al*, 1999).

The drinking water legislation includes regulations regarding the monitoring of water supplies; the protection of human health; and the necessary remedial action following an exceedance of a parametric value. Forty-eight parameters (see pages 7-8) are listed and for each parameter, a parametric value is given. A monitoring result which exceeds the parametric value is termed an exceedance or non-compliance. An exceedance requires investigation as to the cause and, if necessary, remedial action or the provision of an alternative supply. Indicator parameters differ from the microbiological and chemical parameters in that a single exceedance is not notified to the EPA unless it poses a risk to human health (EPA Booklet No 1). Some parametric values are health based while others are based primarily on operational, aesthetic, odour or taste considerations.

In addition to the parameters listed in the legislation, monitoring is required for substances and micro-organisms for which no parametric value has been specified, if there is reason to suspect that such substances or micro-organism may be present in amounts or numbers that constitute a potential danger to human health.

An exceedance does not necessarily mean an immediate risk to public health.

The EPA Booklet No. 1 details the investigations into non-compliances of *E. coli*, coliforms, lead, copper and nickel parameters and the actions to be taken to deal with microbiological, turbidity and other exceedances e.g. arsenic.

Most exceedances relate to microbiological parameters as they are more frequently sampled. Most exceedances are managed entirely within the framework of the Water Services Authority either by adjustment of disinfection or by flushing/scouring the pipework. A minority of exceedances become an incident which requires an interagency IRT.

A Water Services Authority may apply for a departure from the chemical parametric values. Departures are not available for failures to meet the standards for *E. coli* and Enterococci.

The principles and an algorithm for risk assessment are outlined in the following section. Where HSE risk assessment indicates a need for advice and/or action to protect the health of the public, the HSE decision should be evidence based, documented and include a qualifying statement to the effect that advice is specific in time, location and population.

Summary guidance for **HSE Drinking Water Health Advice** for individual parameters is being developed and will be available on the HSE intranet Drinking Water A-Z Directory.

Risk Assessment

The nature and extent of the appropriate HSE response to an exceedance will vary according to the particular circumstances, and will be influenced by detailed knowledge of the history of the water quality in the supply and gastro-intestinal illness trends in the geographical area supplied by the water. Local knowledge will aid in the interpretation of trends in water quality indicators and determine a level for investigation and action, based on careful and thorough risk assessment. **Public health action is rarely required following a single exceedance.** Usually a repeat sample and further information are required. It is not always appropriate to specify exact levels where particular actions are required. Over emphasis on numerical guidelines can lead to compliance with the numbers becoming the primary focus.

When a water sample result exceeds a parametric value the first step is to consider whether the sample is valid and representative of the water supply (see Box 1).

Box 1: Parametric value exceedance: sample issues

Sample issues

Is the result reliable?

- Sample taken by person familiar with sampling procedures, storage and transport?
- Any potential for mislabelling of sample?
- Consider reliability of sampling point (has it been used before?)
- Type of tap/abstraction point

Laboratory/test issues

- Accredited test method/accredited laboratory?
- Typographical error?
- Any pattern of abnormal results from other supplies on the same day?
- Availability of concurrent samples from other agencies/laboratories?

Other factors

- Does the result make sense i.e. is it plausible in view of profile of supply?
- Abnormally low free chlorine residual detected?
- Recent plumbing alterations at/near sampling point?
- Possibility of cross-connections or mixing of supplies?

If the sample is not considered valid then a repeat sample is required.

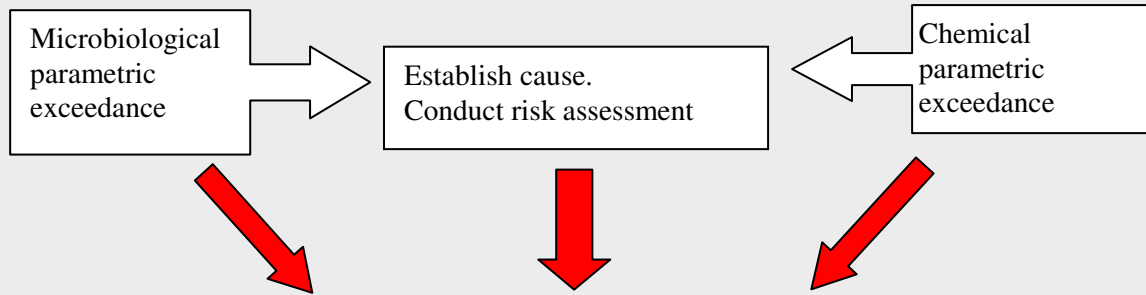
If the sample is considered to be a valid sample of the water supply at the sampling point, then there are a number of *supply issues* that should be considered (see Box 2).

Box 2: Sample is a valid sample of the water supply at the sampling point

Supply issues

- Is the water at this point representative of the supply as a whole?
- Source of water – groundwater, surface water, natural well
- Type of supply - public mains supply, private personal well, private supply
- Water treatment process – type of treatment
- History of water quality on the supply
- Volume of water and number of hours from source to tap
- Geographical area of distribution and any sensitive populations in the area

Algorithm for risk assessment of a parametric exceedance



Non-exhaustive risk assessment checklist

- Number and type of organisms (microbiological)
- Evidence of illness in community
- Consumer complaints
- Remedial actions already taken
- Level of immunity in population
- Size of population affected
- Source of water
- Catchment area protection
- Distribution
- Previous history
- Recent changes to water supply system
- Extreme weather
- Recent incident
- Reservoir storage capacity of supply
- Operation of plant
- Vulnerable groups among consumers
- Food premises supplied
- Potential for acute toxicity at concentration detected (chemical)
- Potential for chronic toxicity at concentration detected (chemical) with regard to remediation timeframe
- Refer also to other parameter-specific algorithms

Decision based on risk assessment (to be recorded)

 Risk

Boil water notice or health advice or restriction on use of supply as appropriate

 No risk

Continue to use supply for drinking water

Resample to verify ongoing effectiveness of controls/remedial actions/status of supply

Microbiological Exceedances

Where a microbiological exceedance results in human illness there may be a considerable time lag between the ingestion of contaminated water and onset and notification of illness. However, relative to chemical contamination, microbiological exceedances are likely to have an early rather than delayed impact on health.

A potential problem with the water supply may not be detected until a number of cases of human illness have been notified to the MOH. A contaminated water event may have happened 1-14 days before cases of the disease appear. Incubation periods of 4-24 hours point to waterborne diseases such as salmonellosis, shigellosis or norovirus; incubation periods of 1-2 weeks suggest illnesses such as giardiasis, cryptosporidiosis, hepatitis or typhoid fever.

The presence of certain bacteria such as total coliforms or *Clostridium perfringens* may not necessarily mean an actual risk to human health but does provide a warning of a failure in water treatment or in the integrity of the distribution system.

For details on individual microbiological parameters see;

- Appendix 3: Total coliforms
- Appendix 4: *E. coli*
- Appendix 5: *Clostridium perfringens*
- Appendix 6: *Cryptosporidia*.

Microbiological exceedances may also present as:

- **high turbidity**, or variation in turbidity or rapid rate of increase. Turbidity adversely affects the efficiency of chlorination;
- **low residual chlorine** level (< 0.1 mg/L) in chlorinated drinking water (indicates an insufficient level of disinfection at the sampling location which may be due to insufficient chlorination at the treatment plant or in the distribution system).

Problems with high turbidity, or low chlorine residuals in treated water are early indications of a possible problem, which may result in cases of waterborne disease in the community after a few days or weeks (AWWA, 2001).

It is necessary to know the **pH** of water, because more alkaline water requires a longer contact time or higher free residual chlorine level for adequate disinfection. The optimum pH required is in the range 6.5 to 9.5. Chlorination may be ineffective above pH 9 while very low values may be corrosive.

Chemical Contamination

Chemical contamination of drinking water differs from microbiological contamination in a number of ways:

- Over a million chemicals exist, many synthetically produced, compared with a relatively small number of infectious agents
- Many chemicals are not named in the legislation as parameters (with parametric values). The rationale for inclusion and exclusion of chemical parameters is listed in the chemical summary tables (Annex 4) in WHO 2006
- Information on toxicity for humans is limited for many chemicals
- Chemical exposure may come from multiple sources and exposure from drinking water is only one component of the total individual exposure risk (to a particular chemical) which must be assessed
- Infectious agents usually have a short-term risk associated with a defined incubation period while chemicals in drinking water are more likely to have long-term effects which may involve carcinogenesis
- Most guideline values for chemicals are precautionary to protect the most vulnerable section of the population; they include a safety factor and are based on lifetime consumption of drinking water. Thus, although most guideline values are health based, a single or short term exceedance does not always equate to immediate health risk. Health risk depends on the nature of the chemical, magnitude and duration of exceedance, safety factor built into the guidelines and the vulnerability of population/sub population. For short term exposure additional exposure guideline values may be more appropriate for risk assessment.

The identity of a chemical may be obvious because of the situation e.g. water treatment chemical, lorry spillage or industrial source. Where this is the case, information on the chemical can be obtained from the company involved. If the chemical is unknown, consult with the laboratory undertaking the investigation. If their range of test facilities is not sufficient it may be necessary to arrange for samples to be sent to a specialist accredited laboratory. If the chemical(s) are identified on a screening system which gives qualitative data only, then quantification should be requested.

Most guideline values for chemical parameters are derived by allocating a proportion of the TDI or ADI to drinking water and making an allowance for exposure from other sources, particularly food. This allocation is often 10%, but may vary from 1% to 80% - allocation factors are given in WHO background documents. When rapid decision making is required it may be possible to allow 100% of the TDI to come from drinking water for a short period (e.g. a few days).

For some chemicals, guideline values are derived from studies in humans and, in most cases (e.g. benzene), relate to long term exposure. For such chemicals, short term exposure to concentrations higher than the guideline value are unlikely to be of significant concern, but this needs to be confirmed by expert advice. In other cases guideline values are based on acute health effects in a vulnerable subgroup. For example, the guideline value for nitrate relates to the risk of methaemoglobinaemia in bottle-fed infants and is more than adequately protective for older children and adults.

Exposure to chemicals in drinking water is calculated on the assumption of an average daily intake of 2 litres per day for adults and 1 litre per day for children. Interpretation of health

risk in a particular incident may be complex and require additional expert public health advice. There is no national advisory centre on chemical hazards in the Republic of Ireland, similar to the HPSC for communicable diseases. Public Health Departments are contracted to the Chemical Hazards and Poisons Division, Health Protection Agency in the UK for advice. Additional sources of advice include the Public Analyst, EPA, DoHC, FSAI toxicologist and other specialist agencies e.g. toxicology units, laboratories, advisory services and toxicology databases.

An algorithm for the consideration of a chemical contaminant (or chemical parameter exceedance) in drinking water and a checklist for water related chemical incidents are available in Appendix 7 and 8 respectively. An algorithm for nitrate exceedance is available in Appendix 9.

References

AWWA Research Foundation. (2001). Waterborne Gastrointestinal Disease Outbreak Detection #447. Available for subscribers at www.awwarf.org/research/TopicsAndProjects/projectSnapshot.aspx?pn=447

EPA (2007). Drinking Water Regulations Guidance Booklet No. 1. (Guidance for Local Authorities on Regulation 9 and Regulation 10 of the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007). Issued November 2007. EPA: Wexford.

European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007). The Stationery Office: Dublin.

Fairley CK, Sinclair MI, Rizak S (1999). Monitoring drinking water: the receding zero. *The Medical Journal of Australia*; **171** (8): 397-398.

FSAI (2008). Cryptosporidium, Protecting your food business.

Hunter PR (2000). Advice on the response from public health and environmental health to the detection of cryptosporidial oocysts in treated drinking water. *Communicable Disease and Public Health*; **3**: 24-27.

National Disease Surveillance Centre. (2004). Report of the Waterborne Cryptosporidiosis Subcommittee of the Scientific Advisory Committee. NDSC: Dublin.

Scottish Executive (2003). Guidance on public health action following the detection of raised concentrations of cryptosporidium in public drinking water supplies in Scotland.

WHO (2001). Water Quality - Guidelines, Standards and Health: Assessment of risk and risk management for water-related infectious disease. IWA Publishing: London.

WHO (2003). Assessing Microbial Safety of Drinking Water: Improving Approaches and Methods. WHO Drinking Water Quality Series.

WHO (2006). Guidelines for Drinking Water Quality, First Addendum to 3rd Edition, Vol 1 Recommendations. WHO: Geneva.

WHO (2007). Chemical safety of drinking water: Assessing priorities for risk management. WHO: Geneva.

Chapter 6 - Surveillance of Waterborne Illness

Surveillance and control of infectious diseases is the responsibility of the MOH, i.e. the Director of Public Health (DPH) or designee. National surveillance of infectious diseases is the responsibility of the HPSC. The situation is less clear in relation to illness caused by chemical contamination. A list of possible waterborne pathogens is given below. Most of these pathogens can be transmitted by other means, as well as by water.

Known Waterborne Pathogens

Bacteria <ul style="list-style-type: none">▪ <i>Campylobacter</i>▪ <i>Leptospira interrogans</i>▪ <i>Shigella</i>▪ <i>Salmonella</i> species▪ <i>Salmonella typhi</i>▪ <i>Salmonella paratyphi</i>▪ <i>Vibrio</i> species▪ VTEC (e.g. <i>E. coli</i> O157)▪ <i>Yersinia</i>	Enterovirus <ul style="list-style-type: none">▪ Hepatitis A▪ Hepatitis E*▪ Norovirus▪ Polio▪ Rotavirus Protozoa <ul style="list-style-type: none">▪ Blue-Green Algae*▪ <i>Cryptosporidia</i>▪ <i>Entamoeba histolytica</i>*▪ <i>Giardia</i>▪ <i>Legionella</i>
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* not currently notifiable

The most common waterborne pathogens are those that have high infectivity and either can proliferate in water or possess high resistance to decay outside the body. Most waterborne pathogens are introduced into drinking water supplies in human or animal faeces, do not grow in water and initiate infections in the gastrointestinal tract following ingestion. However, some organisms can grow in water distribution systems e.g. *Legionella*. Other possible routes of transmission are inhalation and contact.

The effects of exposure to pathogens are not the same for all individuals or populations. Some organisms may cause illness only in people with impaired immune systems (Glasmacher *et al*, 2003) or in vulnerable groups such as the elderly and very young.

Repeated exposure to a pathogen may be associated with a lower probability or severity of illness because of acquired immunity. For some pathogens (e.g. hepatitis A virus) immunity is lifelong, whereas for others the protective effects may be restricted to a few months (e.g. *Campylobacter*).

Legal Background for Infectious Diseases

- **The Health Act, 1947**, entitles the Minister for Health and Children to specify by regulation the diseases that are infectious diseases and covered by legislation.
- The principal current regulations regarding notification of infectious diseases are contained in the **1981 Infectious Disease Regulations (S.I. No 390 of 1981)**. The list of notifiable diseases was revised in 1985, 1988 and 1996 and 2004.
- The **Infectious Diseases (Amendment) (No. 3) Regulations 2003 (S.I. No 707 of 2003)**, which came into effect on January 1st 2004 establishes a revised list of

notifiable diseases and introduces a requirement for laboratory directors to report infectious diseases.

The 2003 amendment introduces case definitions for infectious diseases, for the first time in Ireland and has added cryptosporidiosis to the list of notifiable diseases. A set of case definitions has been drawn up, in line with standardised European case definitions. Under the amended regulations, outbreaks, unusual clusters or changing patterns of illness that may be of public health concern must also be reported. The amendment also states that a standard form for the purpose of returning infectious disease notifications shall be compiled and circulated by the NDSC (now HPSC).

- The **Infectious Diseases (Amendment) Regulations 2000 (S.I. No 151 of 2000)** requires the MOH to make weekly returns of infectious diseases notifications to the Director of the NDSC, rather than to the Minister for Health and Children. It also provided for the provision by health boards (now HSE) to the Minister or to the Director of the NDSC of a detailed report on each case of such infectious diseases as may be specified from time to time.
- **Infectious Diseases (Amendment) Regulations 2004 (S.I. No 865 of 2004)** reflect structural changes in the Health Service and provides for the notification of infectious diseases to the HPSC which has taken over the functions of the NDSC. It also defines the MOH as an appropriately qualified registered medical practitioner who is an employee of the HSE and is designated in writing by the HSE to perform the functions of the MOH under the Health Acts 1947-1953.

Surveillance Information

Surveillance information on waterborne, or suspect waterborne, illness in humans comes from three sources:

- **clinical** notification of infectious diseases;
- **laboratory** notification of pathogens;
- **outbreak** surveillance information.

An agreed dataset of information is collected on each case of infectious disease clinically notified or reported from laboratories. This enables analysis of cases by time, place and person and early identification of outbreaks. Enhanced surveillance is carried out for some pathogens e.g. VTEC, meningitis and more detailed information is collected. There is some variation in the level of routine data collection around the country depending on resources and prioritisation. Notification forms and enhanced surveillance forms are available at www.hpsc.ie.

CIDR is an information system developed to manage the surveillance and control of infectious diseases in Ireland. Clinical and laboratory based information is entered and linked at local level by laboratories and Public Health Departments. CIDR is a shared national information system for the CIDR partners - all HSE regions, HPSC, FSAI, *safefood* and the Department of Health and Children. National implementation was commenced in 2005.

Routine mapping of cases by water supply zone is not carried out, but such mapping constitutes an important aspect of investigating a potential cluster of cases in time or place.

The first indication of a problem in water quality may be observed as a rise in cases of acute infectious gastroenteritis or cryptosporidiosis in a particular supply zone.

If water quality indicators suggest a threat to human health, surveillance should be enhanced and case finding optimised. This may include infections that are not normally notifiable.

Enhanced surveillance may include:

- contacting GPs/GP co-ops and hospitals (incl. A&E Depts) to identify additional cases
- monitoring symptoms in congregate settings (e.g. nursing homes and schools)
- monitoring antidiarrhoeal sales in pharmacies
- requesting laboratories to increase testing for the relevant organism/pathogen, if not routinely sought
- identifying school absence rates
- monitoring weekly returns of cases of gastroenteritis in sentinel GP practices
- monitoring hospital admissions, A&E consultations etc.

Uses of routine surveillance information

1. provides baseline levels of illness against which trends can be measured both at local level by MOH/Public Health Departments and at national level by HPSC
2. detects outbreaks of illness with potential links to drinking water where routine water monitoring programmes may not be sensitive enough to establish contamination or treatment failure (e.g. *Cryptosporidium*, VTEC)
3. may identify emerging pathogens
4. forms an important element of a shared approach by Water Services Authorities and HSE to evaluating drinking water treatment programmes
5. can provide reassurance to the public, in situations where water contamination has been confirmed, that the impact of incident on human health has not been significant
6. provides data for epidemiology.

There is no routine surveillance for illness caused by chemical exposure. However surveillance may be established for potential effects of chemical exposure, for example by contacting local GPs, Pharmacists, Hospital A&E Departments concerning any unusual patterns of illness. The need for a special investigation or study may be considered. A “**Protocol for the investigative approach to serious animal/human health problems**” was devised in 1997 following the Askeaton investigation (EPA *et al*, 1997).

References

Bouchier I. (1998). Cryptosporidium in water supplies. Third Report of the Group of Experts to the Department of the Environment, Transport and the Regions and Department of Health.

EPA and Departments of Agriculture and Food, Health, Environment, Heritage and Local Government. (1997). Protocol for the investigative approach to serious animal/human health problems. Kelleher K *et al* (1997). Disease Cluster Investigation Protocol.

Glasmacher A, Engelhart S and Exner M. (2003). Infections from HPC organisms in drinking-water amongst the immunocompromised. In: Bartram J, Cotruvo J, Exner M, Fricker C, Glasmacher A (Eds). Heterotrophic plate counts and drinking-water safety: the significance of HPCs for water quality and human health. WHO, IWA Publishing: London. pp 137-145.

Health Act, 1947. No. 28 of 1947. The Stationery Office: Dublin.

Infectious Diseases Regulations 1981 (S.I No 390 of 1981). The Stationery Office: Dublin.

Infectious Diseases (Amendment) Regulations 2000 (S.I. No 151 of 2000). The Stationery Office: Dublin.

Infectious Diseases (Amendment) (No. 3) Regulation 2003 (S.I. No 707 of 2003). The Stationery Office: Dublin.

Infectious Diseases (Amendment) Regulations 2004 (S.I. No 865 of 2004). The Stationery Office: Dublin.

Nichols *et al* (2006). Cryptosporidiosis: A report on the surveillance and epidemiology of Cryptosporidium infection in England and Wales. Drinking Water Directorate Contract Number DWI 70/2/201.

Chapter 7 - Outbreaks

When drinking water is associated, or suspected to be associated, with actual illness in the exposed population, an outbreak investigation may be triggered.

Specific objectives include:

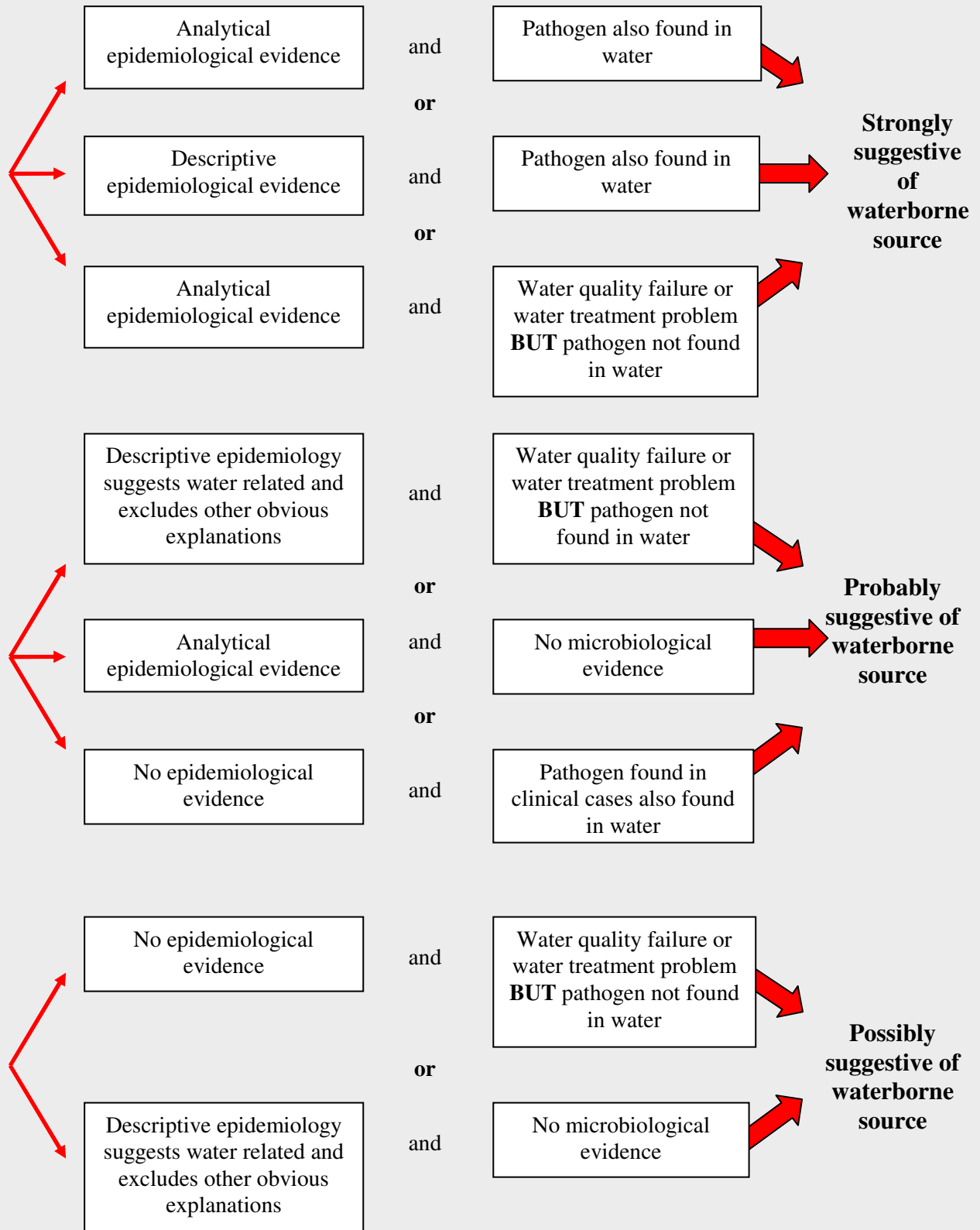
- control of outbreak
- identification of factors that contributed to outbreak
- identification of populations at risk of disease
- acquisition of epidemiological data for risk assessment
- fulfil legal obligations and duty of care
- improve knowledge of disease transmission, microbial ecology, host factors promoting disease development and spread, and control measures
- evaluation of effectiveness of public health programmes
- provision of training opportunities for staff
- dissemination of knowledge/findings to relevant stakeholders by publication/presentation of outbreak investigation
- stimulation of research that will help in the prevention of similar outbreaks.

The scale of an outbreak may range from a local outbreak to a more general one. Localised outbreaks may be confined to one household, a number of neighbouring houses, or the occupants of a larger building, and are usually related to a source external to the distribution system. General outbreaks are usually related to a water quality problem in the source water or at the water treatment facility. Such outbreaks are characterised by major public concern, in-depth media investigations, extreme pressure to quickly identify the cause, and to explain treatment practices and results (AWWA, 2001).

National documents give guidance for the specific management of outbreaks of cryptosporidiosis and legionnaires' disease (www.hpsc.ie). Local guidelines have been developed in many HSE areas. Currently there are no nationally agreed outbreak management guidelines. Reports from various outbreaks/incidents are available on the HSE intranet Drinking Water A-Z Directory.

A framework for assessing factors suggestive of a waterborne source for an outbreak is summarised on the following page.

Factors suggestive of waterborne source for an outbreak



Adapted from PHLS (1996).

When investigating the likely cause of an outbreak three levels of evidence may be considered.

1. **Microbiological Evidence:** This can often provide the strongest evidence of a chain of infection between a possible vehicle of infection and cases of human disease. The greater the degree of definitive identification (for example strain typing using PCR technology or molecular typing identification using Pulsed Field Gel Electrophoresis) of the isolate obtained from the vehicle and from the patient, the greater the degree of certainty that the vehicle was responsible for the human illness.
2. **Epidemiological Evidence:** Even in the absence of definitive microbiological evidence it is possible, using descriptive and analytical epidemiological techniques (for example by means of cohort or case-control studies), to demonstrate an epidemiological association between exposure to an implicated vehicle and the likelihood of development of disease. In most outbreaks, while it is often fairly straightforward to isolate pathogens responsible for the human illness, isolation of pathogens from environmental samples (including food and water) is often much more difficult given the lag period between exposure and investigation. In such cases, epidemiological evidence becomes crucial in demonstrating an association between the suspect vehicle and likelihood of disease. Analytical studies will often allow this association to be quantified.
3. **Circumstantial Evidence:** In epidemiology, as in law, circumstantial evidence is indirect evidence. Circumstantial evidence may provide important corroborative evidence when combined with microbiological or epidemiological evidence. In the absence of strong microbiological and epidemiological evidence a number of separate pieces of circumstantial evidence may provide sufficient grounds to suspect a potential source of infection and be sufficient to intervene and impose control measures.

Communication Aspects

The importance of inter-agency collaboration, so that a clear message can be delivered to the public, cannot be over-emphasised. Press releases/fact sheets/boil water notices/public health guidelines on waterborne illness/advice for vulnerable groups etc.

There should be a designated spokesperson(s) for any media event or public announcement. It should be decided beforehand whether media releases or appearances are to be joint (Local Authority and HSE) or separate but coordinated. It is crucial that each group sends out the same messages and interpretations.

Management of waterborne outbreak

Note: Should an incident develop into an outbreak, the members of the Incident Response Team (or subset thereof) may then become members of the Outbreak Control Team (OCT).

- Any suspicion of a waterborne outbreak or a water-related cluster of human cases should be discussed by the DPH/SPHM, PEHO and Water Services Authority (Senior Engineer)
- An OCT should be convened as appropriate according to HSE procedures
Key members include:
 - DPH/SPHM, SMO, Surveillance Scientist, PEHO, Consultant Microbiologist, and others as required (e.g. Infectious Disease Consultant, Veterinary Officer, Technical Services, Senior Administrator/Manager, Communications Officer)
 - Designated members of IRT if already in place (dual membership of IRT and OCT by key representatives).
- A detailed log of events should be maintained
- The outbreak investigation includes:
 - preliminary investigation (including case definition)
 - early control measures (as applicable)
 - examination of descriptive epidemiology of cases (including mapping of cases to water catchment area)
 - hypothesis generation re source(s), route(s) of exposure, incidence and prevalence of disease in the community
 - in-depth investigations (including environmental sampling from suspected source(s) and clinical samples). Early referral of stool samples to a Reference Laboratory for typing may help focus the investigation if, for example, an outbreak of cryptosporidiosis is suspected (animal or human source)
 - identification of special needs and sensitive communities (e.g. hospitals, long-term care facilities, hospices, day care facilities, schools, residential institutional facilities, etc)
 - identification of food establishments/plan to deal with queries from same
 - notification of neighbouring HSE areas as appropriate
 - notification of relevant national agencies *vis* HPSC, EPA, DoHC, FSAI
 - consultation with relevant national/international expertise as appropriate
 - data analysis and interpretation (cohort/case control study may be indicated)
 - later control measures (as applicable)
 - communication
 - final outbreak report
 - debriefing

References

AWWA Research Foundation. (2001). Waterborne Gastrointestinal Disease Outbreak Detection #447. Available for subscribers at www.awwarf.org/research/TopicsAndProjects/projectSnapshot.aspx?pn=447

Collins *et al* (2008). The Impact of a contaminated city water supply on an Emergency Department. *Irish Medical Journal*, 101 (3): 78-9.

PHLS (1996) Strength of association between human illness and water: revised definitions for use in outbreak investigations. *CDR Weekly*; 6(8).

Chapter 8 - Deliberate Release

Water quality may be affected by chemical or biological agents, and since the events of September 11th 2001, there has been increasing concern regarding the possibility of a deliberate release of such agents. While some of the agents that have been developed as weapons can be used to contaminate food and water, significant threats are also posed by toxic pesticides and industrial chemicals, as well as microbiological pathogens, such as those that are often inadvertent contaminants of food and water. In addition, certain highly toxic pharmaceuticals could be diverted for terrorist use.

The effects of deliberate contamination of water supply systems are usually limited by dilution, disinfection, filtration, non-specific inactivation (hydrolysis, sunlight, and microbial degradation/predation) and the relatively small amount of water to which individuals are usually exposed compared with the total supply (WHO, 2006). Contamination can have not only the direct effects of injury or illness, but also the indirect effects of denial of the supply of drinking water.

Early detection of contamination or attempted contamination is essential in reducing the likelihood or magnitude of human exposure. The effects of pathogens are often delayed, so that exposure to contaminated products will continue until the contamination or the outbreak is detected. Monitoring for contamination in all drinking water systems should be an integral part of routine quality control.

Activities carried out in response to outbreaks of illness associated with waterborne pathogens are also appropriate to the identification of outbreaks associated with deliberate chemical and biological contamination. In general, separate systems should not be developed specifically for dealing with terrorism or other concerns, such as food safety (WHO, 2006).

Many aspects of the response to deliberate releases are similar to those of accidental contamination incidents and as such much about planning and preparedness is common to both. However, incidents of deliberate release may differ in terms of presentation, composition of the IRT and the decision making process. The IRT may need to consider that water samples may become evidence and the management of these samples will have to be agreed/overseen by the Gardaí. Composition of the IRT will differ in that Gardaí and Army would be involved.

Presentation may be by three main routes:

- **complaints**
- **clusters** of unusual symptoms
- **claims** of deliberate release.

Individual consumers have a significant role to play in detecting both deliberate and inadvertent contamination. Consumers are often the first to detect differences in water quality, e.g. in taste, odour, or colour, and to become aware of health problems caused by water.

International experience suggests that in relation to the decision making process the first decision concerns the credibility of a threat. A waterborne hazard might become apparent to a variety of organisations via different routes. The priority at the initial stage is to decide, in as

short a time as is practicable, whether there is sufficient information to assess if there is a credible threat to public health. Initial communication between agencies should be by telephone and not rely on email or fax. Any decisions made during telephone conversations, together with the underlying rationale, should be recorded by each of the parties at the time. The Gardaí should be alerted if the hazard could have resulted from criminal activity. Where it is clear, at this point that there is no credible threat to public health, then no further formal action need be taken. However the relevant parties may continue to monitor data from routine or appropriately enhanced surveillance and may choose to maintain contact informally.

The WHO Guidelines 3rd edition (WHO, 2006) recommend that Water Services Authorities should develop water safety plans which will be invoked in the event of an emergency or unplanned event. These plans should consider potential natural disasters (e.g. floods), accidents (e.g. spills), damage to treatment plants and distribution systems, and human actions (e.g. strikes, sabotage).

The guidelines state that emergency plans should clearly specify responsibilities for coordinating measures to be taken, a communication plan to alert and inform users of the drinking water supply and plans for providing and distributing emergency supplies of drinking water. Plans should be developed in consultation with relevant regulatory authorities and other key agencies and should be consistent with national and local emergency response arrangements.

Key areas to be addressed in emergency response plans include:

- response actions, including increased monitoring;
- responsibilities and authorities internal and external to the organisation;
- plans for emergency drinking water supplies;
- an evaluation of the basis for issuing water avoidance and boil water notices;
- communication protocols and strategies, including notification procedures (internal, regulatory body, media and public);
- mechanisms for enhanced public health surveillance.

In Ireland the WSNTG (2007) provides “Guidance on Preparing and Implementing a **Drinking Water Incident Response Plan (DWIRP)**”. This guidance proposes that a DWIRP is developed by Water Services Authorities to set out the authority’s strategy for responding to contamination incidents or other emergencies, and that **Water Safety Plans** are developed at scheme level to ensure safety of a drinking water supply from catchment to consumer.

The framework for major emergency management, effective from September 2008, provides the basis for emergency planning and response in Ireland. Regional and local risk assessments are carried out in the eight major emergency management regions to include risks which may involve drinking water.

References

US EPA (2006). A Water Security Handbook: Planning for and Responding to Drinking Water Contamination Threats and Incidents. Chapter 5. Public Health Response Guide, pp 39-44.

WHO (2006). Guidelines for Drinking Water Quality, First Addendum to 3rd Edition, Vol 1 Recommendations. WHO: Geneva.

WSNTG (2007). Drinking Water Incident Management. Guidance on Preparing and Implementing a Drinking Water Incident Response Plan.

Major Emergency Management. www.mem.ie

Physician Preparedness for Acts of Water Terrorism – online readiness guide for health care practitioners. Available at www.waterhealthconnection.org

Recognising Waterborne Disease and the Health Effects of Water Pollution – physician online reference guide. Available at www.waterhealthconnection.org

Chapter 9 - When Normal Water Supply Cannot Be Maintained

A decision to close a drinking water supply carries an obligation to provide an alternative safe supply and is very rarely justifiable because of the adverse effects, especially to health, of restricting access to water.

A range of control measures may be employed to minimise the risk of harm occurring in a population served by an affected water supply. Although it is not feasible to stipulate in advance which control measures will be appropriate for all individual situations, there are a limited number of options in terms of risk management. If the risk assessment indicates that there is a significant probability of harm occurring, or where there is insufficient evidence to decide with confidence and a precautionary approach is favoured, one or more of the following control measures could be put in place:

- Re-routing of the water supplies to provide an alternative source of safe drinking water;
- Reiterating existing advice to vulnerable patient groups only, regarding the safe use of drinking water (e.g. infants should always drink **boiled and cooled** tap water)
- Issuing general advice to the public on action to ensure the safe use of existing water supplies and to major consumers such as food/drinks manufacturers.

For example:

- boil tap water for consumption,
- do not use for drinking, cooking but can use for washing,
- do not use for drinking, cooking or washing.
- Issuing specific advice to haemodialysis patients if required (chemical incidents) or immunocompromised (e.g. suspected *Cryptosporidium*). Measures to prevent drinking-waterborne infections in immunocompromised patients are discussed by Glasmacher *et al* (2003) and NDSC (2004);
- Provision of alternative supplies when necessary (e.g. bowsers and bottled water).

When deciding which option is appropriate in a given situation the IRT should take into account the size and scale of the incident and impact on the community.

When normal water supply cannot be maintained, interruptions in supply may result and the quality of the water may deteriorate. Microbiological contamination may occur due to back-siphonage or the disturbance of biofilms in the water mains. A change in pressure or flow within the water mains may cause disturbance of sediments containing, for example, iron, manganese or aluminium. Particles in suspension may reduce efficacy of disinfection of the water supply and the quality of water supplied may be unreliable. Water contamination may also affect those parts of the supply zone that are protected from cuts. The use of standpipes or bowsers will not guarantee that water supplied is potable. If restriction of supply is unavoidable, non-essential use of water should be reduced to conserve supply.

Cuts to water supply may have other effects. For example, there may be an increased demand for hospital beds due to the admission of patients unable to cope in the community and inability to discharge others in the normal manner. If inadequate water is available for hygiene purposes there may be an increased risk of gastrointestinal illness and infections of the skin or wounds.

Sample boil water notices from Scottish Water are given in Appendix G of WSNTG Guidance on Preparing and Implementing a Drinking Water Incident Response Plan (notices for *Cryptosporidium*, boil, don't drink/cook, don't drink/cook/wash and all clear. Also examples of notices may be included in local HSE/Local Authority communication protocols/guidelines, reports of recent incident/outbreak and a template for a boil water notice is given in the cryptosporidiosis document (NDSC, 2004).

The Decision to Boil

A boil water notice may be considered where there is a danger to public health from biological contamination. In some instances (e.g. *Cryptosporidium*) epidemiological evidence of illness may be the basis for advice, in the absence of laboratory evidence of contamination.

Issuing a boil water notice is a serious measure that should be undertaken only when there is an ongoing risk to public health which outweighs any risk from the boil water notice itself.

The public interest is not always best served by boil water notices, which can have negative public health consequences through scalds and anxiety. In addition, if boil water notices are issued frequently or are left in place for long periods, the public response will decrease. If a notice is issued, advice must be clear and easy to understand, or it may be ignored because of confusion over what to do.

Prior to issuing a boil water notice, it is good practice to establish criteria for removing the notice (see page 49). But this is not always possible. Sometimes it is necessary to issue a boil water notice before lifting criteria can be agreed.

Communicating the Risk

It is the statutory role of the **Water Services Authority to advise consumers** if a public supply becomes a potential danger to human health. However, the **importance of inter-agency collaboration**, so that a clear message can be delivered to the public, cannot be overemphasised. The IRT agrees the content and method(s) of information dissemination. Communication to the public may include:

- briefing of public representatives
- house to house distribution of boil water notice
- press releases
- public notices e.g. church, schools
- fact sheets/FAQs
- public health information leaflet on waterborne illnesses, including specific advice for vulnerable groups where appropriate
- radio and television interviews
- website
- helpline.

If possible advance notice of the cut schedule should be provided. If the incident is prolonged regular updates may help to allay public concerns.

While the Water Services Authority has a responsibility to advise all consumers, additional advice may be provided directly by the HSE. For example, the Environmental Health Departments may give specific advice to food premises, crèches and health care

facilities, while Public Health Department may contact GPs, Consultants, schools and colleges. Notification arrangements may be outlined in local protocols/guidelines. Other agencies with an enforcement food role may need to be informed e.g. Department of Agriculture, FSAI, Local Authority Veterinary Officers.

When interruptions to water supply occur special consideration should be given to key settings and vulnerable groups where the interruption poses a greater than average risk. Key settings and vulnerable groups should be identified and their supply protected and maintained if at all possible.

Key Settings:

- Hospitals
- Hospices
- Nursing and residential homes
- Schools, pre-schools, colleges
- Day-care centres
- Health Centres, GP and Dental surgeries
- Food production premises and pharmaceutical industries

Health and other care premises require a continuous water supply for a number of purposes, including: personal hygiene, hygiene in operating theatres, sterilisers, cooling of powered instruments in dentistry, food preparation and domestic cleaning. If satisfactory arrangements cannot be made to maintain supplies sufficient to guarantee a satisfactory level of hygiene the temporary closure of establishments such as schools, nurseries and offices may be warranted.

Food businesses including milk producers merit special consideration and advice because of the vulnerability of their product. Food businesses and pharmaceutical industries may need to consider whether they can continue to operate safely.

Hairdressers, swimming pools and spas may need special consideration in the event of algal contamination when direct skin effects may be problematic.

Vulnerable groups for consideration:

- Infants
- Elderly
- Visitors to the area
- Home haemodialysis patients
- Immunocompromised patients

Local arrangements may be needed to ensure that home haemodialysis patients may dialyse in hospital if their domestic water supply is interrupted. In addition, those with mobility problems due to age, disablement or disease, who cannot fetch water from standpipes or fill buckets from their taps to cope with periods of interrupted supply, may also be vulnerable. Local health workers including GPs should be able to identify those at risk.

In relation to infants the FSAI (1999 and personal communication 2008) recommends that infant feeds should be prepared with tap water that has been brought to the boil once and

cooled. Water that has been reboiled several times should not be used. There are some concerns regarding the use of bottled water that has high concentrations of sodium when reconstituting infant feeds. However, the maximum level of sodium permitted in tap water is 200 mg/litre and it would be extremely rare that tap water had any concentrations near this limit. Almost all bottled water is well below this 200 mg/litre level.

If a commercial bottled water meets suitability criteria for use for preparation of infant feeds it will need to be boiled in the same manner as tap water. Ready-to-use formula that does not require re-constitution with water can also be used.

Ending the Incident

Ideally, the criteria for lifting a control measure should be agreed by the IRT at the same time as the decision is taken to impose the measures. However, circumstances often make this difficult. In this situation, action to protect public health should not be delayed and the criteria for lifting control measures should be decided by the IRT as soon as practical thereafter.

The criteria for standing down an incident will be set by the IRT on the basis of best available evidence and advice. These criteria should take into consideration the balance of risks associated with continuing any restrictions, against the health risk associated with the waterborne hazard. Criteria may include concentration of the contaminant, remedial action, cases of human illness and timescale involved. In some instances, e.g. chemical and algal contamination, it may be necessary to flush storage tanks. This may involve running a hot tap for 30-60 minutes, depending on tank capacity, to release stored water. The water treatment should not be such that other parameters are exceeded, for example elevated trihalomethanes resulting for increased chlorination.

Lifting criteria agreed by HSE and EPA

- Water monitoring results satisfactory/indicate compliance
- Treatment is effective and commissioned (commissioning statement)
- Epidemiological evidence that the outbreak is over/return to background levels of human illness
- The treatment is sustainable

The decision to declare the incident over will be taken when the IRT is satisfied that the hazard is adequately controlled.

Following control of a hazard, resumption of the normal public water supply and completion of all investigations, a debriefing meeting of the IRT should be held and a report compiled and distributed to relevant organisations.

References

Food Safety Authority of Ireland. (1999). Recommendations for a national infant feeding policy. FSAI: Dublin.

Glasmacher A, Engelhart S and Exner M. (2003). Infections from HPC organisms in drinking-water amongst the immunocompromised. In: Bartram J, Cotruvo J, Exner M, Fricker C, Glasmacher A (Eds). Heterotrophic plate counts and drinking-water safety: the significance of HPCs for water quality and human health. WHO, IWA Publishing: London. pp 137-145.

National Disease Surveillance Centre. (2004). Report of the Waterborne Cryptosporidiosis Subcommittee of the Scientific Advisory Committee. NDSC: Dublin.

WSNTG (2007). Drinking Water Incident Management. Guidance on Preparing and Implementing a Drinking Water Incident Response Plan.

Chapter 10 - Fluoridation

Legislation

In accordance with the Health (Fluoridation of Water Supplies) Act 1960 a Health Authority must arrange for the fluoridation of water supplied to the public by the Water Services Authorities. Under the fluoridation legislation monthly monitoring of fluoridated public water supplies is carried out, usually by the Health Service Executive through Environmental Health Departments. Following the recommendations of the Forum on Fluoridation (2002) the Fluoridation of Water Supplies Regulations 2007 (S.I. No. 42 of 2007) was enacted and specifies the amount of fluoride permitted in drinking water in Ireland. Under Article 6 it says “The amount of fluoride which may be added to public water supplies shall be such that the water, after the addition of fluoride, shall contain **not more than 0.8 milligrams of fluoride per litre (mg/l)** of water, and **not less than 0.6 milligrams of fluoride per litre (mg/l)** of water”. This brought about a reduction from the previous 0.8 – 1.0 mg/l.

Benefits and Risks of Water Fluoridation

Current evidence shows that water fluoridation at the optimal level recommended in Ireland is a safe and effective public health measure in the prevention of dental decay. There is a substantial body of literature comparing the prevalence and severity of dental decay among populations living in communities with differing levels of fluoride in the water supply.

Prior to water fluoridation national surveys were conducted in the period 1961 to 1963 which provided baseline information on dental decay levels. During the following 30 years local and national surveys have monitored the effectiveness of water fluoridation in the control of dental decay. A National Survey of children’s dental health in 1984 found that the level of dental decay in 5, 8, 12 and 15 year old children was substantially lower in those who had been lifetime residents of fluoridated communities when compared with those residing in non-fluoridated communities (O’Mullane *et al*, 1986).

A national survey of adult dental health was conducted in 1990. It was found that residents who lived in fluoridated communities for many years had better dental health than those who were resident in non-fluoridated communities (O’Mullane and Whelton, 1992).

Concerns have been expressed both in Ireland and in other countries about possible health effects from fluoridation. One concern is dental fluorosis which is a cosmetic condition resulting from excessive fluoride exposure during dental development that causes teeth to become discoloured and the enamel of teeth to look spotted, pitted, or stained. There is some evidence that the prevalence of dental fluorosis is increasing in Ireland (Forum on Fluoridation, 2002). Dental fluorosis occurs in Ireland at almost the very mild to mild level characterised by faint white flecks on the surface of the teeth. It is often only detectable by a dentist. It is hoped that the lowering of the level of fluoride that is now added to water under the Fluoridation of Water Supplies Regulations 2007 will go some way to addressing this issue.

In 2002 the Food Safety Authority of Ireland carried out a risk assessment of the fluoride intake of infants under four months as a result of the consumption of infant formula reconstituted with fluoridated water. It concluded that there is no significant evidence to suggest that the ingestion of infant formula reconstituted with fluoridated water is a risk factor

for any condition other than dental fluorosis of the permanent teeth. The risk of moderate fluorosis is very low in exclusively formula-fed infants aged 0-4 months residing in areas in which the level of fluoride does not exceed the statutory limit. In areas where the limit is consistently exceeded the risk is also considered to be very low, but the safety margin is reduced. It is recommended that parents should continue to reconstitute infant formula with boiled tap water in accordance with manufacturers' instructions (Anderson *et al*, 2004).

The FSAI risk assessment has been validated by the study 'Fluoride intake in Infants', (Whelton *et al*, not yet published) which concluded that the results of the study were similar to the results of the risk assessment undertaken by the FSAI. It further concluded that the Fluoridation of Water Supplies Regulations, amended in early 2007 to redefine the optimal level of fluoride in tap water from 1ppm to a range of 0.6 - 0.8ppm with an optimal target of 0.7ppm, will decrease the fluoride intake of infants consuming formula reconstituted with fluoridated water and further lower the risk of dental fluorosis.

In 2000, the Faculty of Public Health Medicine of the Royal College of Physicians of Ireland published a report which endorsed the safety and effectiveness of water fluoridation.

Forum on Fluoridation

In 2000 the Minister for Health and Children established the Forum on Fluoridation due to increased public interest and concern over water fluoridation. The Forum recommended that the fluoridation of piped public water supplies should continue as a public health measure (Forum on Fluoridation, 2002). In the light of the best available scientific evidence, the Forum recommended the lowering of the fluoride level in drinking water from the present level of 0.8 to 1.0 mg/l to a range of 0.6 to 0.8 mg/l, with a target value of 0.7 mg/l. This recommendation is now enshrined in Irish legislation through the 2007 Regulations. In the opinion of the Forum this lower level of fluoride would be sufficient, together with the continued use of fluoride toothpaste, to maintain reductions in dental decay rates and reduce the occurrence of dental fluorosis. The recommended level takes into account the multiple sources of fluoride to which the population is exposed.

Irish Expert Body on Fluorides and Health

Among the recommendations of the Forum was the establishment of an Expert Group to implement the recommendations of the Forum and to advise the Minister for Health and Children on an ongoing basis on all aspects of fluoride and its delivery methods. In 2004 the Irish Expert Body on Fluorides and Health was established (chair: Dr. Seamus O'Hickey), with representatives from the Environmental Health Service and Public Health Physicians.

Monitoring Arrangements

A wide variety of fluoride dosing and monitoring technologies are in current use, and are largely dependent on the age, site and size of the water treatment plant. The Fluoridation of Water Act, 1960, requires that a daily colorimetric test is carried out to determine the fluoride level in the water. The aim is to maintain a level of free fluoride ion between 0.6 and 0.8 mg/l. The sample for fluoride measurement is generally taken below the injection point at the waterworks by the engineering staff of the Local Authority, and at intervals at other points in the distribution system, such that the whole system is tested over a period of time. A report summarising the results of the colorimetric tests carried out by the Local Authority should be

forwarded to the HSE each month, with a copy also forwarded to the Department of Health (Department of Health, 1969).

The regulations also require that fluoride levels are determined in the distribution system using the distillation test, at intervals not exceeding four weeks, from different points in the distribution system. This is arranged through the Public Analyst Laboratories, and is intended to be an independent check on the fluoride content of the water. EHOs carry out this monthly monitoring of fluoride levels and make quarterly returns to the DoHC. Monitoring Committees meet at least twice a year or fluoridation may be included in the work of the Water Liaison Committees. Since 1977 Local Principal Dental Surgeons have overall responsibility for fluoridation, however the National Expert Group is considering a revised and clearer line of responsibility.

The Forum on Fluoridation made recommendations on the need to update monitoring, analytical and reporting procedures to reflect modern technologies and to facilitate timely reporting of drinking water fluoride levels. In 2007 the Irish Expert Body on Fluorides and Health issued a code of practice on the fluoridation of drinking water (see Appendix 2). During 2008 a structured programme of independent auditing of all fluoridated water supplies in the country was undertaken to assess compliance with the code of practice.

References

Anderson WA, Pratt I, Ryan MR, Flynn A (2004). A probabilistic estimation of fluoride intake by infants up to the age of 4 months from infant formula reconstituted with tap water in the fluoridated regions of Ireland. *Caries Research*, 38 (5), 421-429.

Department of Health. (1969). Fluoridation of Public Water Supplies. Department of Health, Circular 18/69.

Fluoridation of Water Supplies Regulations 2007 (S.I. No. 42 of 2007). The Stationery Office: Dublin.

Forum on Fluoridation (2002). The Stationery Office: Dublin.

Health (Fluoridation of Water Supplies) Act, 1960. No. 46 of 1960. The Stationery Office: Dublin.

O'Connor M, Fitzpatrick P, Johnson H, Thornton L, on behalf of the Faculty of Public Health Medicine, RCPI (2000). Water Fluoridation and Public Health. Dental Health Foundation and Faculty of Public Health Medicine: Dublin.

O'Mullane D, Clarkson J, Holland T, O'Hickey S, Whelton H. (1986). Children's dental health in Ireland 1984. The Stationery Office: Dublin.

O'Mullane D, Whelton H. (1992). Oral Health of Irish Adults 1989-1990. The Stationery Office: Dublin.

The Irish Expert Body on Fluorides and Health (2007). Code of Practice on the Fluoridation of Drinking Water 2007.

Appendices

Appendix 1: Relevant Websites

Appendix 2: Drinking Water Legislation and Regulations

Appendix 3: Algorithm for Total Coliforms

Appendix 4: Algorithm for *Escherichia coli*

Appendix 5: *Clostridium perfringens*

Appendix 6: Algorithm for *Cryptosporidia*

Appendix 7: Algorithm for Exceedance of Chemical Parameter or Chemical Contamination of Water

Appendix 8: Chemical Incident Checklist: Water Incidents

Appendix 9: Algorithm for Nitrate Exceedance

Appendix 1 - Relevant Websites

Agency for Toxic Substances and Disease Registry (ATSDR)
(Public Health Statements, Toxicological Profiles, ToxFAQs and Medical Management Guidelines)
www.atsdr.cdc.gov

Department of the Environment, Heritage and Local Government
www.environ.ie

Drinking Water Inspectorate
www.dwi.gov.uk

Environmental Protection Agency
www.epa.ie

EPA Office of Environmental Enforcement
www.enforcementnetwork.ie

Food Safety Authority of Ireland
www.fsai.ie

Health Protection Agency
www.hpa.org.uk

Health Protection Surveillance Centre
www.hpsc.ie

Health Service Executive Intranet – Drinking Water
http://hsenet.hse.ie/HSE_Central/Population_Health/Health_Protection/Drinking_Water/
and
http://hsenet.hse.ie/HSE_Central/Population_Health/Environmental_Health/

Irish Expert Body on Fluorides and Health
www.fluoridesandhealth.ie

Irish Statute Book
www.irishstatutebook.ie

National Federation of Group Water Schemes
www.nfgws.ie

Safefood
www.safefoodonline.com

Water Services National Training Group
www.wsntg.ie

WHO Drinking Water Quality
www.who.int/water_sanitation_health/dwq/en/

Appendix 2 - Drinking Water Legislation and Regulations

Local Government (Sanitary Services) Acts

The primary statute law relating to the abstraction of water, provision of water supplies and the disposal and treatment of sewage by Local Authorities is contained in the Local Government (Sanitary Services) Acts, 1878–1964. The Code includes the following Acts.

The Waterworks Clauses Act, 1847

This Act specifically prohibits contamination of any stream or reservoir used as a public water supply or any aqueduct or any part of supply system. This Act is fully repealed by the Water Services Act 2007.

The Waterworks Clauses Act, 1863

This Act makes it an offence for any person negligently to allow pipes etc to be out of repair so that water is wasted or contaminated or impurities are allowed enter the supply system. Section 13 to 15 and 18 to 21 are repealed by the Water Services Act 2007. Sections 16 and 17 will be repealed when Section 56 WSA 2007 (Water Conservation) is commenced.

Public Health (Ireland) Act, 1878

Under Section 61, 65 and 74, Sanitary Authorities are empowered to provide a district with a supply of water which is both proper and sufficient for both public and private purposes and must provide and keep in their waterworks a supply of pure and wholesome water.

Public Health Acts Amendment Act 1907

Under Section 35, any system used for the supply of water for domestic purposes which is so kept as to render the water liable to contamination and a possible danger to health is regarded as a statutory nuisance.

Local Government (Sanitary Services) Act, 1948 (No. 3 of 1948)

Under Section 27 a Sanitary Authority may take a sample of water from any supply (public and private) serving any inhabitants of their sanitary districts for the purpose of analysis. Sections 10, 11, 18 and 26 to 29 are repealed by the Water Services Act 2007.

Local Government (Sanitary Services) Act, 1962 (No. 26 of 1962)

Section 8 enables the Sanitary Authority in certain circumstances to require the owner of a premises within their district to connect the premises to the public sewage system, or to the public water supply system. Sections 1, 8, 9 and 11 to 15 are repealed by the Water Services Act 2007.

Local Government Water Pollution Acts 1977 and 1990

The Acts provide for licensing requirements in relation to discharges to water courses. A person shall not discharge or permit the discharge of any trade effluent or sewage effluent to any waters except under or in accordance with a licence.

"Trade effluent" means effluent from any works, apparatus, plant or drainage pipe used for the disposal of waters or to a sewer of any liquid (whether treated or untreated), either with or without particles of matter in suspension therein, which is discharged from premises used for

carrying out any trade or industry (including mining), but does not include domestic sewage or storm water.

"Sewage effluent" means effluent from any works, apparatus, plant or drainage pipe used for the disposal of waters of sewage, whether treated or untreated.

Sections 24 and 25 of the 1990 Act are repealed by the Water Services Act 2007.

Water Services Act 2007 (No. 30 of 2007)

The Act incorporates a comprehensive review, update and consolidation of all existing water services legislation, and facilitates the establishment of a comprehensive supervisory regime to ensure compliance with specified performance standards. It includes provision to:

- consolidate water services law into a single modern code, for ease of access and application,
- introduce a licensing system to regulate the operations of group water services schemes,
- amend the Environmental Protection Act 1992 to assign responsibility for supervision of sanitary authority water supplies to the Agency.
- strengthen administrative arrangements for planning the delivery of water services at national and local level, and
- place duties of care on users of water services in relation to water conservation, protection of collection and distribution networks, and prevention of risk to public health and the environment.

The Act replaces the term Sanitary Authorities with Water Services Authorities.

The Water Services Act 2007 repealed some of the older legislation, as follows;

- The Waterworks Clauses Act 1847 is fully repealed,
- The Waterworks Clauses 1863 - Sections 13 to 15 and 18 to 21 repealed. When Section 56 WSA 2007 (Water Conservation) is commenced, Sections 16 and 17 will be simultaneously repealed,
- Local Government (Sanitary Services) Act 1948 - Sections 10, 11, 18 and 26 to 29 are repealed,
- Local Government (Sanitary Services) Act 1962 - Sections 1, 8, 9 and 11 to 15 are repealed,
- Local Government Water Pollution Act 1990 - Sections 24 and 25 are repealed.

Water Services Act 2007 (Commencement) Order 2007 (S.I. No. 846 of 2007)

The first Commencement Order for the Water Services Act 2007 brings most of the key operational provisions of the Act (such as provisions relating to connections to services, metering, installation of infrastructure and related duties of care) into force, with effect from 31st December 2007. It provides for the commencement of some 85 of the 116 sections in the Act. The remaining provisions will be rolled out over a number of phases as many of these require further consultation with stakeholders and the preparation of regulations and guidelines before they are commenced.

Fluoridation

Health (Fluoridation of Water Supplies) Act, 1960 (No. 46 of 1960)

The Act gave health authorities general responsibility for the fluoridation of water supplies specified in regulations made by the Minister in pursuance of the Act. The responsibility for fluoridation of water supplies was transferred to Health Boards from April 1st 1971, under the Health Act of 1970, with the Sanitary Authority continuing to be responsible for the operation of fluoridation on an agency basis. Under this legislation monthly monitoring of fluoridated public water supplies is carried out by the Health Authorities (see Chapter 10).

Fluoridation of Water Supplies Regulations 2007 (S.I. No. 42 of 2007)

These Regulations specify the amount of fluoride in drinking water in Ireland. Article 6 holds that *“The amount of fluoride which may be added to public water supplies shall be such that the water, after the addition of fluoride, shall contain not more than 0.8 milligrams of fluoride per litre (mg/l) of water, and not less than 0.6 milligrams of fluoride per litre (mg/l) of water.”* This brought about a reduction from the previous 0.8 – 1.0 mg/l.

Code of Practice on the Fluoridation of Drinking Water 2007

The Code of Practice on Fluoridation was compiled by the Irish Expert Body on Fluorides and Health and was forwarded to all Local Authorities with responsibility for provision of drinking water. The Expert Body was set up by the Department of Health and Children in line with recommendations made by the Forum on Fluoridation Report 2002. The Code deals with a description of the process of fluoridation including managing critical control points, site security, bulk delivery and storage of hydrofluosilicic, dosing, monitoring, auditing the system, training of personnel and Health and Safety considerations. The Code supersedes previous circulars on Fluoridation from the DoHC.

Health Acts

Health Act 1970

This Act established the Health Boards in Ireland. Section 25 of the Act deals with arrangements between Health Boards and Local Authorities –

25. (1) *Where (a) a Local Authority is of opinion that it would be more convenient that any power, function or duty which may be exercised or performed by it should be exercised or performed, whether generally or in a particular case, by a Health Board, and*

(b) The Health Board is able and willing so to exercise or perform the power, function or duty,

the authority and the board may, with the consent of the Minister for Local Government, make an arrangement for the power, function or duty to be exercised or performed on behalf of the Authority by the Board, and it shall thereupon become so exercisable or performable by the Board.

(2) *The making of an arrangement under section (1) shall be a reserved function of the Local Authority.*

(3) *Where a Local Authority is of the opinion that it would be convenient for the duties in relation to its powers and functions to be performed by an officer of the health board, that duty may be assigned by the chief executive officer of the health board in the same way as duties relating to the powers and functions of the board.*

(4) Where the chief executive officer of a health board is of opinion that it would be convenient that duties relating to any of the powers or functions of the board or its officers should be assigned to an officer of a Local Authority, those duties may be assigned to such an officer by the Local Authority in the same way as duties under the Local Authority.

Health Act 2004

The Health Service Executive was established on January 1st 2005 and replaced the ERHA and Health Boards.

Infectious Diseases (Amendment) Regulations, 2004 (S.I. No. 865 of 2004)

Infectious Disease (Amendment) Regulations 2004 reflect structural changes in the Health Service and provides for the notification of infectious diseases to the HPSC which has taken over the functions of the NDSC. It also defines the MOH as an appropriately qualified registered medical practitioner who is an employee of the HSE and is designated in writing by the HSE to perform the functions of the MOH under the Health Acts 1947-1953.

International Health Regulations (2005)

The International Health Regulations (IHR) 2005 came into force on 15th June 2007. The purpose and scope of these Regulations are to prevent, protect against, control and provide a public health response to the international spread of diseases in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade.

The regulations require States Parties to notify a potentially wide range of events to WHO on the basis of defined criteria indicating that the event may constitute a *public health emergency of international concern*. Each country is required to establish a National IHR Focal Point and corresponding contact persons or officials. The National IHR Focal Point means “the national centre, designated by each State Party, which shall be accessible at all times for communications with WHO IHR Contact Points under these Regulations”. HPSC has been established as Ireland’s National Focal Point for communicable disease: Dr Darina O’Flanagan and Dr Kevin Kelleher are the 2 named contact points.

In the event of a Public Health Emergency of International Concern, information will need to be circulated to relevant personnel rapidly within the health system. Information from the health system will also need to be gathered, collated and reported internationally to WHO.

Countries have two years to assess their capacity and develop national action plans followed by three years to meet the requirements of the regulations regarding their national surveillance and response systems as well as the requirements at designated airports, ports and certain ground crossings.

Water Legislation

European Community Regulations

Currently the Quality of Bathing Waters Regulations, 1992 (S.I. No. 155 of 1992) are in place and set out the standards for bathing water. However, Bathing Water Quality Regulations 2008 (S.I. No. 79 of 2008) transpose EU Bathing Water Directive 2006 (Directive 2006/7/EC of 15 February 2006) and come in to effect from the beginning for 2015. These latter Regulations aim to:

- improve health protection for bathers
- establish a more pro-active approach to management of bathing waters, and
- promote increased public involvement and dissemination of information to the public.

The 2008 Regulations establish a new classification system for bathing water quality based on four classifications “poor”, “sufficient”, “good” and “excellent” and generally require that a classification of at least “sufficient” be achieved by 2015 for all bathing waters. Local Authorities must take appropriate measures with a view to improving waters which are classified as “poor” and increasing the number of bathing waters classified as “good” or “excellent”. A permanent advice against bathing must be issued in a case where bathing water is classified as “poor” for five consecutive years. Local Authorities are required annually to identify bathing waters, establish a monitoring calendar, carry out the specified monitoring, report the results to the EPA, carry out appropriate management measures where necessary and provide information to the public. There must be public participation in the identification of waters and the general implementation of the Regulations. The EPA is required by the Regulations to classify bathing waters, generally on the basis of the monitoring results for the four preceding bathing seasons, and to publish an annual report in relation to bathing water quality. Monitoring by Local Authorities is to commence not later than 2011 with a view to ensuring that a classification is assigned to bathing waters not later than 2015. Private controllers of access lands may be required to contribute towards the costs incurred by a Local Authority or the EPA.

The 1992 Regulations set out the following water quality standards;

The parameter total coliforms standard is (a) $\leq 5,000/100$ ml, (b) $\leq 10,000/100$ ml. (To be confirmed with (a) by 80% or more of samples and, in the case of (b), by 95% or more of samples. Standard not to be exceeded by any two consecutive samples in any case.)

The parameter faecal coliform standard is (a) $\leq 1,000/100$ ml, (b) $\leq 2,000/100$ ml. (To be confirmed with (a) by 80% or more of samples and, in the case of (b), by 95% or more of samples. Standard not to be exceeded by any two consecutive samples in any case).

These parameters provide helpful guidelines when deciding on appropriate advice for the public concerning use of water for personal hygiene during a water alert.

European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations 1989 (S.I. No. 294 of 1989)

These regulations relate to surface water sources used or intended for use in public water supplies, are concerned with the quality of raw water and the appropriate treatment methods to produce drinking water. The following responsibilities are placed on Local Authorities to:

- classify surface waters used or intended for abstractions in accordance with specified quality standards

- prepare action programmes, where appropriate for improvement of water quality
- monitor the quality of surface water.

They do not apply to private water supplies or to either public or private supplies abstracted from groundwater sources.

European Communities (Drinking Water) Regulations 2007 (S.I. 106 of 2007)

These Regulations prescribe quality standards to be applied, and related supervision and enforcement procedures in relation to supplies of drinking water, including requirements as to sampling frequency, methods of analysis, the provision of information to consumers and related matters. The Regulations also provide for supervision of sanitary authority supplies by the EPA. Sanitary authorities will continue to be responsible for supervising group scheme supplies, but all monitoring programmes will in future be subject to approval by the Agency. The Agency will in turn be required to supervise the performance by sanitary authorities of their monitoring functions and supervisory authorities will have powers of direct intervention if necessary to ensure compliance with their instructions. The Regulations revoke the European Communities (Drinking Water) Regulations 2000 (S.I. No. 439 of 2000).

European Communities (Drinking Water) (No.2) Regulations 2007 (S.I. 278 of 2007)

These Regulations prescribe quality standards to be applied, and related supervision and enforcement procedures in relation to supplies of drinking water, including requirements as to sampling frequency, methods of analysis, the provision of information to consumers and related matters. The Regulations update the European Communities (Drinking Water) Regulations 2007 (S.I. No. 106 of 2007), which are revoked, to provide for indictable offences. These Regulations further strengthen the Drinking Water Regulations by increasing penalties for non-compliance with the requirements of the Regulations. Refer to Chapter 2 for further details.

European Communities (Natural Mineral Waters, Spring Waters and Other Waters in Bottles or Containers) Regulations 2007 (S.I. No. 225 of 2007)

The EU legislation which relates to mineral water include Council Directive 80/777/EEC, Directive 96/70/EC and Commission Directive 2003/40/EC. In Ireland, the European Communities (Natural Mineral Waters, Spring Waters and Other Waters in Bottles or Containers) Regulations 2007 (S.I. No. 225 of 2007) and the **European Communities (Natural Mineral Waters, Spring Waters and Other Waters in Bottles or Containers) (Amendment) Regulations 2007 (S.I. No. 686 of 2007)** specifies three types of water which can be bottled or packaged: natural mineral water, spring water and all other water. Refer to Chapter 2 for further details.

Environmental Protection Agency

Environmental Protection Agency Act, 1992

The EPA was set up in 1992 and has a supervising role over Sanitary Authorities monitoring of drinking water -

Section 58. (1) (a) *The Agency may require a sanitary authority to submit to it in such manner and at such times as it may direct, such information as the Agency may specify about the monitoring of the quality of water intended for human consumption pursuant to the European Communities (Quality of Water intended for Human Consumption) Regulations, 1988, or any enactment amending or replacing those regulations or any other enactment relating to drinking water as may be prescribed.*

(b) The Agency shall carry out, cause to be carried out, or arrange for, such monitoring as it considers necessary to verify information (including monitoring results) transmitted to it under paragraph (a).

(2) The Agency shall, in relation to each year, prepare and submit to the Minister a report on the monitoring, and an assessment of the results, referred to in subsection (1), and shall include in the report such recommendations as seem to it to be appropriate.

(3) Each report under subsection (2) shall be laid by the Minister before each House of the Oireachtas and shall be published by the Agency.

Section 58 of the EPA Act 1992 requires the Agency to prepare and submit to the Minister for the Environment, Heritage and Local Government a report each year on the monitoring by Water Services Authorities of drinking water supplies and an assessment of the results.

Urban Waste Water Treatment Regulations 2001 (S.I. No 254 of 2001)

These Regulations revoke and generally re-enact in consolidated form the Environmental Protection Agency Act 1992 (Urban Waste Water Treatment Regulations, 1994, as amended) and prescribe a further 30 water bodies as sensitive areas. The Regulations:

- prescribe requirements in relation to the provision of collection systems and treatment standards and other requirements for urban waste water treatment plants, generally and in sensitive areas,
- provide for monitoring procedures in relation to treatment plants and make provision for pre-treatment requirements in relation to industrial waste water entering collection systems and urban waste water treatment plants, and
- give effect to provisions of Council Directive 91/271/EEC of 21 May 1991, as amended, concerning urban waste water treatment, and Directive 2000/60/EC of 23 October 2000 - the Water Framework Directive.

Food Safety Legislation

EC (Hygiene of Foodstuffs) Regulations 2006 (S.I. 369 of 2006) and **European Communities (General Food Law) Regulations 2007 (S.I. No. 747 of 2007)**

“Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28th Jan. 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down the procedures in matters of food safety” defines “food” as including “.. water after the point of compliance as defined in Article 6 of Directive 80/778/EC and without prejudice to the requirement of Directives 80/778/EEC and 98/83/EC.”

Under Regulation 178/2002 as above “Regulation (EC) No. 852/2004 of the European Parliament and of the Council of 29th April 2004 on the hygiene of foodstuffs” was enacted and is enshrined in Irish Legislation through such statutory instruments as the “European Communities (General Food Law) Regulations 2007 (S.I. No. 747 of 2007).

Annex II Chapter VII of 852/2004 above deals with “Water Supply” and Paragraph 1 (a) says that “There is to be an adequate supply of potable water supply, which is to be used whenever necessary to ensure that foodstuffs are not contaminated”.

Appendix 3 - Algorithm for Total Coliforms

Total coliforms are an indicator parameter in the drinking water legislation with a parametric value of 0 per 100mls of water. This parameter is subject to *check monitoring*.

Total Coliforms

- Include a wide range of genera not specific to faecal contamination
- Not necessarily useful as an indicator of faecal contamination
- Can be used as an indicator of treatment effectiveness, to assess cleanliness and integrity of distribution system, and to assess potential presence of biofilms.

Total coliforms belong within the family Enterobacteriaceae. They contain various species of the genera *Escherichia*, *Klebsiella*, *Enterobacter*, *Citrobacter*, *Serratia* and many others. While *E. coli* is the only member of the total coliform group that is found exclusively in faeces, other members of the group are found naturally in water, soil and vegetation, as well as in faeces.

Although the presence of total coliforms is not a reliable indicator of the presence of faecal contamination, the cause of their presence should be investigated and further action taken if necessary (See Algorithm for Coliform Exceedance).

As operational indicators, total coliforms provide information on the adequacy of drinking water treatment and on the microbial condition of the distribution system:

- Total coliform bacteria are easily destroyed during disinfection. Effective treatment including disinfection should yield water free of any coliform organisms, no matter how polluted the source water may have been. The presence of any total coliform bacteria in treated water leaving a plant therefore suggests inadequate treatment and disinfection, is unacceptable and should be corrected immediately (Health Canada, 2006). [Note: treated water should contain residual chlorine at a concentration of 0.5 mg/l for at least 30 minutes contact time prior to supply to consumers to ensure that the disinfection is complete (EPA, 2007)].
- If total coliforms are found in the distribution system, but water tested immediately post-treatment is free of total coliforms, this suggests that regrowth or post-treatment contamination has occurred (Health Canada, 2006). Post-treatment contamination could result from numerous problems such as pipe leaks with negative pressure events, pipe breaks, inadequate cleaning and disinfection after repairs, and cross-connections (including backflow) with non-potable water. In addition, surges in water mains from activities such as hydrant tests and fire-fighting may result in the sloughing of biofilm and a subsequent rise in total coliform bacterial counts (Health Canada, 2006). Microbiological parameters, such as *E. coli* or coliform bacteria, may also be influenced by the design and hygienic status of the consumer's tap (EPA, 2007).

In a distribution system, public health decisions should not be based solely on the presence of total coliforms, in the absence of *E. coli*, unless the investigation indicates a problem that results in a threat to public health (Health Canada, 2006).

If enhanced health surveillance indicates that a waterborne outbreak may be occurring, or if conditions exist that could result in a waterborne outbreak, then the necessity of issuing a boil water notice should be immediately discussed. In the event that an incident that may have contaminated the distribution system or interfered with treatment is known, consumers may be notified immediately to boil the drinking water.

If total coliforms (in the absence of *E. coli*) are confirmed, some or all of the corrective actions listed below may be necessary. The degree of response will depend on the history of the quality of raw water supply, the historical effectiveness of treatment process and integrity of distribution system, and an assessment of the significance and extent of problem.

If corrective actions are deemed necessary, they may include:

- Verification of integrity of treatment process and distribution system
- Verification of required disinfectant residual throughout distribution system
- Increase in chlorine dosage, flushing of water mains, cleaning of treated water storage tanks and checking for presence of cross-connections and pressure losses
- Sample and test sites adjacent to the site(s) of the positive sample(s). Tests performed should include total coliforms, *E. coli*, disinfectant residual and turbidity
- Investigation to identify problem and prevent recurrence
- Continue selected sampling and testing (e.g. bacteriological, disinfectant residual and turbidity) of all identified sites during the investigative phase to confirm the extent of the problem and to verify the success of the corrective actions.

This parameter is being examined as part of the revision of the EC Drinking Water Directive.

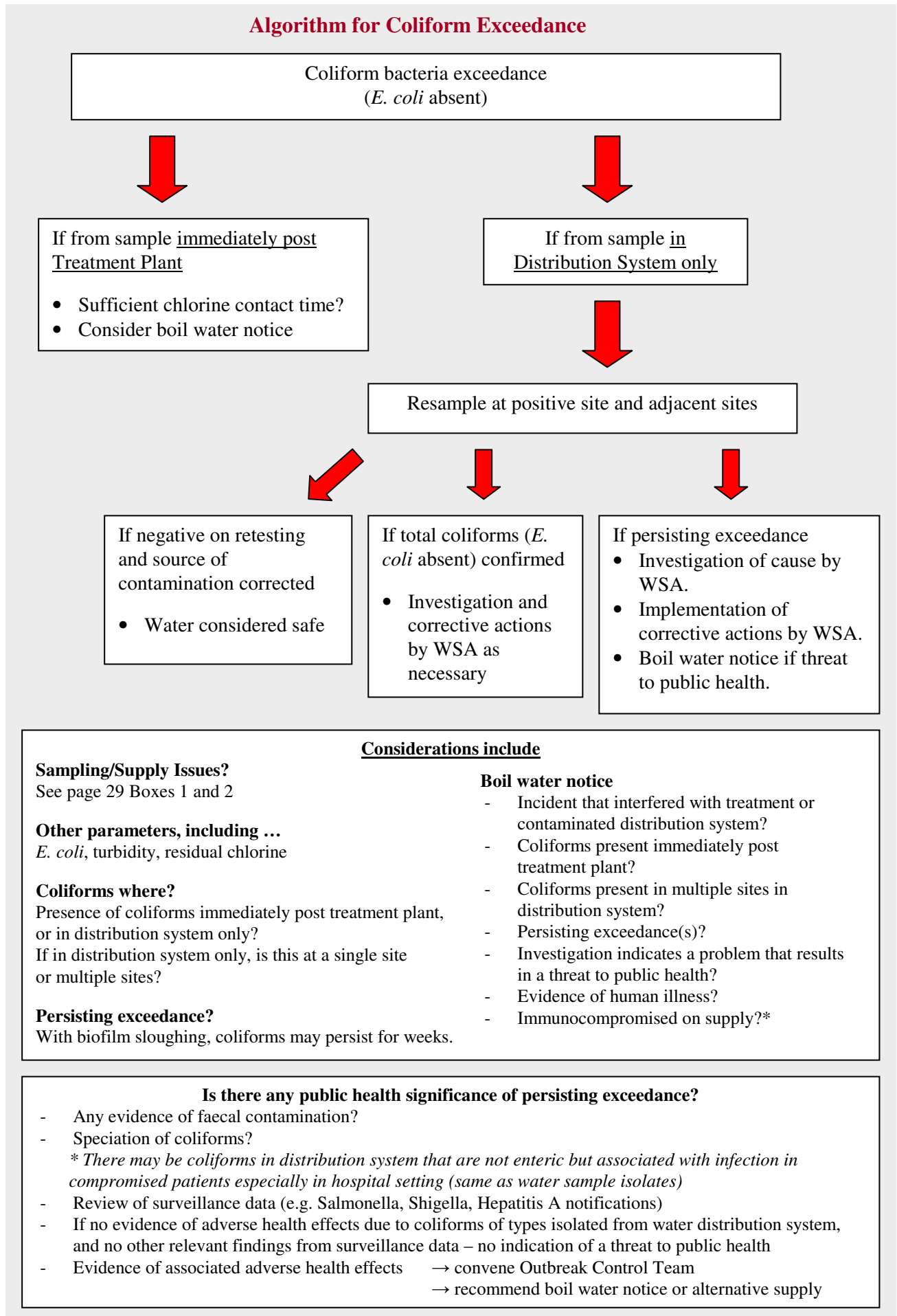
References

EPA (2007). Drinking Water Regulations Guidance Booklet No. 1. (Guidance for Local Authorities on Regulation 9 and Regulation 10 of the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007). Issued November 2007. EPA: Wexford.

Health Canada (2006). Guidelines for Canadian Drinking Water Quality: Guideline Technical Document - Total Coliforms. Water Quality and Health Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

MMWR Weekly (1985). Detection of Elevated Levels of Coliform Bacteria in a Public Water Supply - Connecticut. MMWR Weekly, March 15, 1985, 34(10); 142-4.

Algorithm for Coliform Exceedance



Considerations include

Sampling/Supply Issues?

See page 29 Boxes 1 and 2

Other parameters, including ...

E. coli, turbidity, residual chlorine

Coliforms where?

Presence of coliforms immediately post treatment plant, or in distribution system only?

If in distribution system only, is this at a single site or multiple sites?

Persisting exceedance?

With biofilm sloughing, coliforms may persist for weeks.

Boil water notice

- Incident that interfered with treatment or contaminated distribution system?
- Coliforms present immediately post treatment plant?
- Coliforms present in multiple sites in distribution system?
- Persisting exceedance(s)?
- Investigation indicates a problem that results in a threat to public health?
- Evidence of human illness?
- Immunocompromised on supply?*

Is there any public health significance of persisting exceedance?

- Any evidence of faecal contamination?
- Speciation of coliforms?
* *There may be coliforms in distribution system that are not enteric but associated with infection in compromised patients especially in hospital setting (same as water sample isolates)*
- Review of surveillance data (e.g. Salmonella, Shigella, Hepatitis A notifications)
- If no evidence of adverse health effects due to coliforms of types isolated from water distribution system, and no other relevant findings from surveillance data – no indication of a threat to public health
- Evidence of associated adverse health effects → convene Outbreak Control Team
→ recommend boil water notice or alternative supply

Appendix 4 - Algorithm for *Escherichia coli*

Escherichia coli is a microbiological parameter in the drinking water legislation with a parametric value of 0 per 100mls of water. This parameter is subject to *check monitoring*.

E. coli

- The use of pointer bacteria, in particular *E. coli* and coliform bacteria, as a means of assessing the potential presence of waterborne pathogens, has been paramount to protecting public health.
- *E. coli* is a coliform bacterium that has historically been regarded as the primary indicator of the presence of human or animal faeces. It is sensitive to disinfection and therefore not a good indicator of presence of more resistant organisms.
- There is no absolute correlation between the number of pointer organisms and (a) the actual presence or numbers of enteric pathogens or (b) the risk of illness occurring.

E. coli is a member of the coliform group, part of the family Enterobacteriaceae, and is described as a facultative anaerobic, Gram-negative, non-spore forming, rod-shaped bacterium that possesses the enzyme β -glucuronidase. It is the only member of the coliform group that is found exclusively in the faeces of humans and other animals. Of the coliforms, *E. coli* is generally the most sensitive to environmental stresses. It rarely grows outside the human or animal gut. Its presence in water indicates not only recent faecal contamination but also the possible presence of intestinal disease-causing bacteria, viruses and protozoa.

The detection of *E. coli* in any drinking water system is unacceptable (Health Canada, 2006). Conversely, the absence of *E. coli* in drinking water generally indicates that the water is free of intestinal disease-causing bacteria. However, because *E. coli* is not as resistant to disinfection as intestinal viruses and protozoa, its absence does not necessarily indicate that intestinal viruses and protozoa are also absent.

If *E. coli* is detected in a public drinking water system, and if resampling and testing of the positive site(s) confirm the presence of *E. coli*, a boil water notice should be advised and corrective actions carried out by the Water Services Authority as necessary. Surveillance for possible waterborne disease cases should be conducted. See Algorithm for *E. coli* Exceedance.

Depending on the extent of *E. coli* contamination in the first sampling *e.g.* positive sample results from more than one location in the distribution system, a boil water notice may be advised immediately and corrective actions initiated without waiting for confirmation.

If the presence of *E. coli* in drinking water is confirmed, corrective actions may include the following:

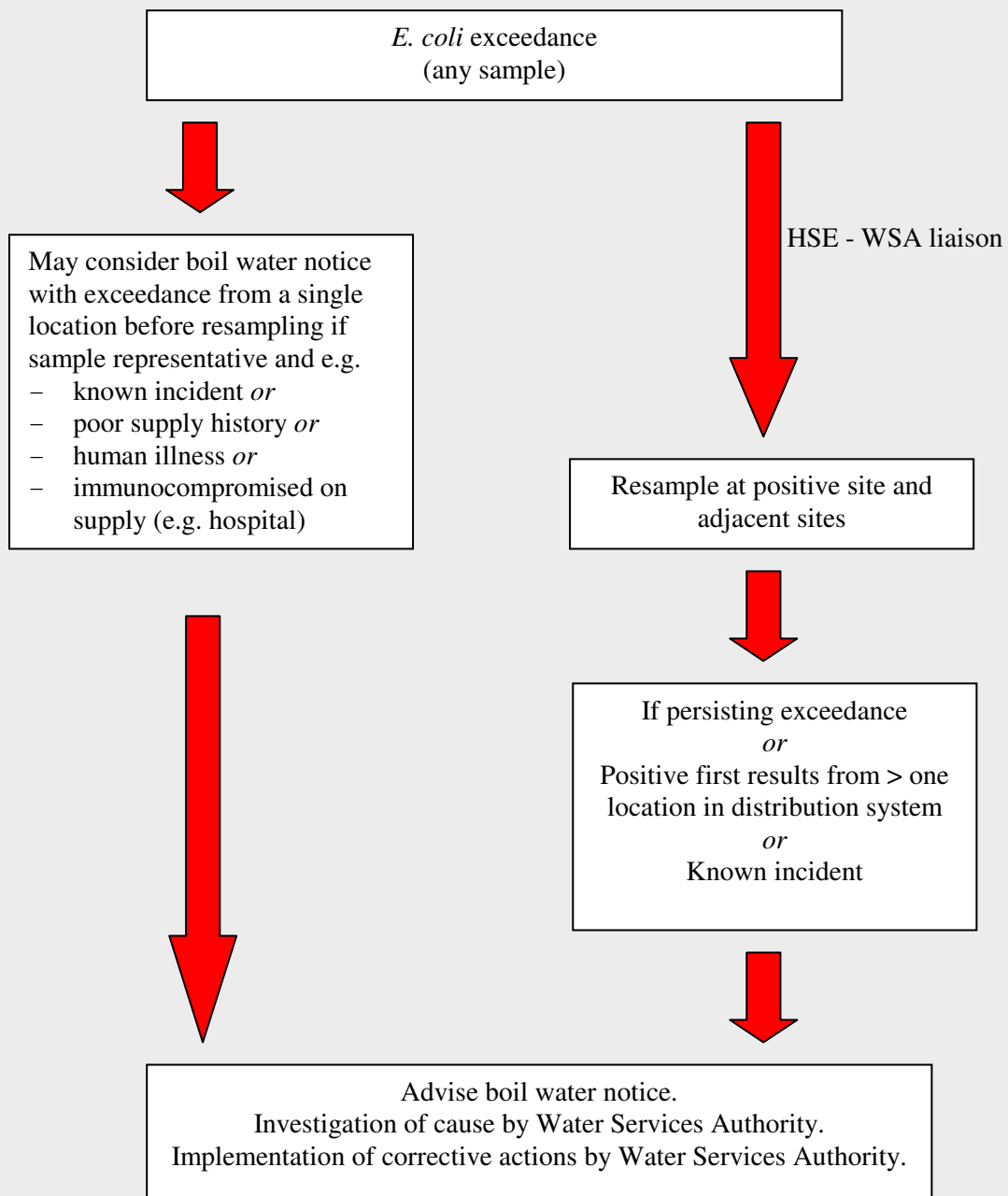
- Verification of integrity of treatment process and distribution system
- Verification of required disinfectant residual throughout distribution system
- Increase in chlorine dosage, flushing of water mains, cleaning of treated water storage tanks and checking for presence of cross-connections and pressure losses

- Sample and test sites adjacent to the site(s) of the positive sample(s). Tests performed should include *E. coli*, total coliforms, disinfectant residual and turbidity
- Investigation to identify problem and prevent recurrence
- Continue selected sampling and testing (e.g. bacteriological, disinfectant residual and turbidity) of all identified sites during the investigative phase to confirm the extent of the problem and to verify the success of the corrective actions.

References

Health Canada (2006). Guidelines for Canadian Drinking Water Quality: Guideline Technical Document - Total Coliforms. Water Quality and Health Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Algorithm for *E. coli* Exceedance



Considerations include

Sampling/Supply Issues?

See page 29 Boxes 1 and 2

Other parameters, including ...

Coliforms, turbidity, residual chlorine

***E. coli* where?**

Single site? Multiple sites?

Persisting exceedance?

Boil water notice

- Human illness?
- Incident that interfered with treatment or contaminated distribution system?
- Persisting exceedance?
- Exceedance in multiple sites in distribution system?

Human disease surveillance

- If evidence of cases → Outbreak Control Team

Appendix 5 - *Clostridium perfringens*

Clostridium perfringens is an indicator parameter but need not be measured unless the water originates from or influenced by surface water. The legislation requires that in the event of non-compliance with this parametric value, the supply shall be investigated to ensure that there is no potential danger to human health arising from the presence of pathogenic micro-organisms e.g. *Cryptosporidium*.

Clostridium perfringens is normally present in faeces. They are not recommended for routine monitoring of distribution systems because they can survive a long time after (and far from) a pollution event, leading to possible alarms. The presence of *Clostridium perfringens* in ground waters in the absence of *E. coli* and enterococci points to pollution at some time in the past and suggests the source may be liable to intermittent contamination. The spores are relatively resistant to disinfection and must be removed by some form of filtration. Their presence in treated water suggests deficiencies in treatment filtration processes. It may indicate the potential for protozoan cysts (such as *Cryptosporidia* or *Giardia*) to have passed through the treatment process (WHO, 2003). The absence of *Clostridium perfringens* does not necessarily mean that *Cryptosporidium* is also absent.

When there is an exceedance of *Clostridium perfringens*, the Water Services Authority will assess the need to test for *Cryptosporidium*. If *Clostridium perfringens* or *Cryptosporidium* is detected the HSE should be informed.

This parameter may be examined as part of the revision of the EC Drinking Water Directive. The EPA Drinking Water Report 2006-2007 mentions that although *Clostridium perfringens* is a useful indicator of faecal pollution (particularly groundwater) it should not be relied upon exclusively as an indicator for *Cryptosporidium*. The European Microbiological Advisory Group (EMAG), which was set-up as an advisory group to the Drinking Water Directive, has advised that the evidence for a relationship between the occurrence of *Clostridium perfringens* and *Cryptosporidium* is inconclusive and recommended consideration of its removal from the Directive.

References

WHO (2003). Assessing Microbial Safety of Drinking Water: Improving Approaches and Methods. WHO Drinking Water Quality Series.

Appendix 6 - Algorithm for *Cryptosporidia*

A drinking water supply may become contaminated with substances or micro-organisms for which there is no specified parametric value listed in the legislation. Monitoring is required (by the legislation) for such substances and micro-organisms if there is reason to suspect that they may be present in amounts or numbers that constitute a potential danger to human health.

There is no direct relationship between levels of *Cryptosporidium* detected and human illness. Outbreaks of human illness have occurred in the absence of *Cryptosporidium* identified in a water supply and conversely *Cryptosporidium* has been detected in water supplies in the absence of associated human illness. Therefore, interpretation of *Cryptosporidium* monitoring results and implications for human health depend on a number of factors including adequacy of sample, pathogenicity of species, viability of oocysts, vulnerability of individuals on the supply and the level of community immunity. Other factors to be considered are the source of the water, the treatment process and the history of monitoring results on the supply. An assessment of the potential to public health is laid out in the “Algorithm for *Cryptosporidia* in treated drinking water” on the next page.

Clostridium perfringens is listed as an indicator parameter and monitoring is required if the water originates from or is influenced by surface water. In the event of non-compliance with the parametric value of 0/100ml, the supply should be investigated to ensure that there is no potential danger to human health arising from the presence of pathogenic micro-organisms e.g. *Cryptosporidium*.

As cryptosporidiosis may be a severe illness the decision to give advice to vulnerable groups may be considered e.g. infants, immunocompromised, elderly and visitors to area. The procedures to be followed in the event of an outbreak of cryptosporidiosis are set out in the cryptosporidiosis report (NDSC, 2004). Output from the 2007 EPA Cryptosporidium group is available at www.enforcementnetwork.ie.

References

Hunter PR (2000). Advice on the response from public health and environmental health to the detection of cryptosporidial oocysts in treated drinking water. *Communicable Disease and Public Health*; **3**: 24-27.

National Disease Surveillance Centre. (2004). Report of the Waterborne Cryptosporidiosis Subcommittee of the Scientific Advisory Committee. NDSC: Dublin.

Algorithm for *Cryptosporidia* in Treated Drinking Water

Detection of *Cryptosporidium* oocysts in treated water



Contact laboratory to ensure validity of result



Assessment of Potential Risk to Public Health - consider Hunter (2000) criteria

Human Disease

- Current disease
- Past history of disease
- Level of population immunity
- Vulnerable groups/ institutions/individuals /settings served by water supply

Characteristic and management of water supply

- Water supply crypto risk assessment score
- Water source and treatment (filtered/unfiltered/UV), and any recent variations
- Efficacy of water treatment/problems
- Distribution area/size of population served
- Likelihood that contaminated water still in distribution system
- Storage capacity of supply

Results of water testing

- Location and time of sample(s)
- Representativeness of sample
- Sample size and procedure used for sampling
- Laboratory used for testing
- Number (type and viability of oocysts if available)
- Sampling history
- Water results history (incl. turbidity history)
- Actions to date

Decision based on risk. Record basis for decision

Likely immediate danger to public health



- Advise boil water notice *or*
- Request water supplier to provide alternative water supply *or*
- Enhance treatment
- Inform consumers

Insufficient evidence of immediate danger to public health



- Enhance water monitoring
- Case finding/enhance disease surveillance
- Investigate cause of adverse water result
- Monitoring to assess efficacy of control measures

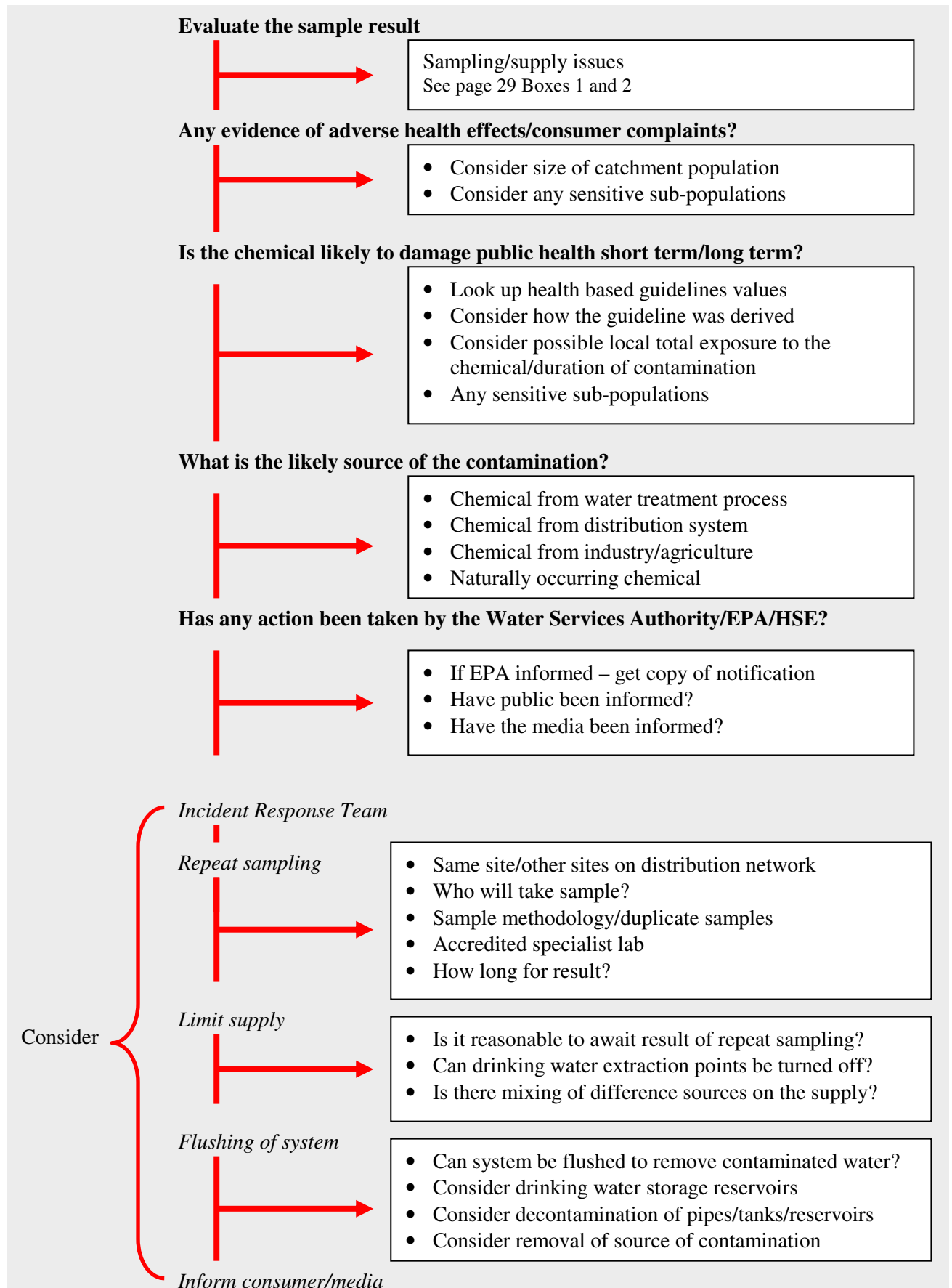
Risk insufficient to warrant immediate action



- Ongoing monitoring of the situation and liaison between PH, EH and water supplier
- Monitoring to assess efficacy of control measures



Appendix 7 - Algorithm for Exceedance of Chemical Parameter or Chemical Contamination of Water



Appendix 8 - Chemical Incident Checklist: Water Incidents

(From Public Health Emergency Planning. Guidance for Departments of Public Health Medicine. 2005. Appendix 8. Chemical Incident Emergencies. Guidance for Public Health Physicians.)

Which water supply has been affected?

- Description of the supply network, reservoirs, treatment plants etc
- Is water from different sources mixed in the supply?
- Any other relevant information regarding facilities with vulnerable population or industry on the supply network e.g. pre-schools/crèches, hospitals, nursing homes, food processing, food premises, home dialysis patients' homes etc.

What is the contaminant involved?

How much contaminant is involved?

When did contamination occur?

- Description of the contamination
- How long did the contamination last?
- How was the incident discovered?
- Was remediation undertaken?
- What is the nature of remediation?
- What testing has been done?
- What was and is the pH of the water?

What population was exposed?

Have the public been notified? If yes how have they been notified?

Have there been public complaints or queries?

- Describe complaints - number, nature and location

Has there been a response by the Water Services Authority to these complaints?

- Do you anticipate further communication with the public?

Are there plans to set up an Incident Response Team?

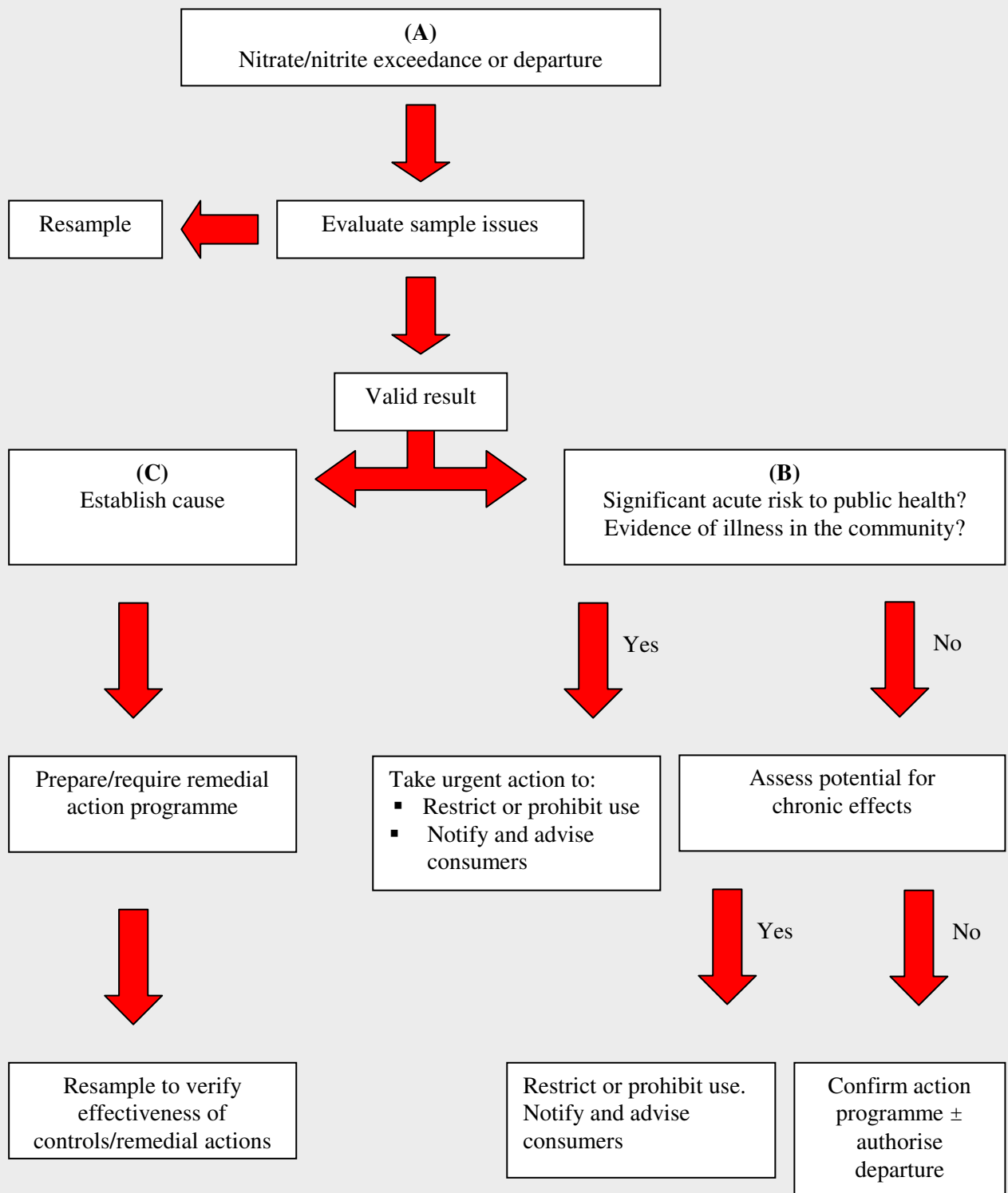
Expertise that the Department of Public Health might offer

- Determination of the human health effects of the contamination
- Risk communication

Adapted from: HPA Checklist: Water Incidents.

Consult the HPA Checklist for more information to aid risk assessment in A-Z at www.hpa.org.uk

Appendix 9 - Algorithm for Nitrate Exceedance



Note: A, B and C explained on following page

**(A) European Communities (Drinking Water) (No. 2) Regulations 2007
(S.I. No. 278 of 2007)**

Nitrate (NO₃): 50 mg/L

Nitrite (NO₂): 0.5 mg/L (at the tap)
0.1 mg/L (ex treatment works)

Compliance must be ensured with the conditions that $[\text{nitrate}]/50 + [\text{nitrite}]/3 \leq 1$, the square brackets signifying the concentrations in mg/L for nitrate (NO₃) and nitrite (NO₂) and the value of 0.10 mg/l for nitrites ex water treatment works.

Example of sample evaluation issues:

- Sample date, location
- Other sample results on same day or since
- Supply issues – size, type, distribution, treatment process, history
- Previous sample results and averages of these results
- Other parameter values especially microbial
- Laboratory issues

(B) Health Effects

Short-term: Excessive levels of nitrate in drinking water have caused serious illness and sometimes death. The serious illness (methaemoglobinaemia) in infants is due to the conversion of nitrate to nitrite by the body, which can interfere with the oxygen-carrying capacity of the child's blood. This can be an acute condition in which health deteriorates rapidly over a period of days. Symptoms include shortness of breath and blueness of the skin.

Long-term: Nitrates and nitrites have the potential to cause outcomes from long-term exposure at levels above the maximum contaminant level (MCL) including possible reproductive/developmental effects. It is known that nitrites can react with certain amine-containing substances found in food to form nitrosamines, which are known to be potent cancer causing chemicals.

Vulnerable groups:

Bottle-fed infants less than 6 months old.

(C) Examples of causes of elevated nitrate/nitrite in source water

- Excessive spread of manures, fertilizers or bio-solids
- Intensive stock densities
- Poor waste-water management
- Excessive irrigation
- Heavy rainfall/storm water overflows
- Discharges from Section 4 Licences
- Discharges from EPA licensed facilities
- Discharges from septic tanks or other treatment systems