SECTION 4: GUIDANCE ON SAMPLING

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Section 4: Guidance on Sampling

Summary of Section 4

- Describes the difference between "compliance monitoring" and operational monitoring".
- Sets out the recommended contents of the sampling manual by reference to pre-determined compliance and operational sampling programmes and sampling procedures.
- Describes compliance sampling from consumers' taps in the distribution network and from water leaving the treatment works including the pre-determined sampling programme, sampling points, delineation of supply zones and selection of the premises to be sampled.
- Sets out advice on compliance sampling for special groups of parameters.
- Describes the compliance sampling from tankers when Water Services Authorities (WSAs) need to deploy them.
- Provides guidance on the operational sampling programme for raw water, treatment works and distribution networks, including the parameters to be monitored and the frequencies.
- Describes other situations when WSAs may be required to take samples.
- Sets out advice on the training, supervision and monitoring of samplers.

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1. Introduction

1.1 | Water Services Authorities (WSAs) take samples for two types of monitoring of water supplies. The first type is **"compliance monitoring"** to determine whether water supplies comply with the standards and indicator parameter values in the Regulations. The compliance monitoring samples should be analysed in accredited laboratories (see section 5). The second type is **"operational monitoring"** to check that treatment works and distribution networks are operating effectively to deliver water that meets the standards and to provide early warning that source water quality is deteriorating, a treatment process is failing or there is a problem in the distribution network. The operational monitoring samples need not be analysed in accredited laboratories – they may be analysed in small laboratories/benches at treatment works provided the methods are properly calibrated and subject to analytical quality control. WSAs should have separate pre-determined sampling programmes for compliance and operational monitoring.

1.2 | Sampling is a very important part of the monitoring procedure. If the samples are not representative of the water supplied or the samples are not taken correctly, there is no point in carrying out expensive analysis because the results will have little use. Therefore the Environment Protection Agency (the EPA) recommends that each WSA has a **sampling manual** that sets out all the procedures and precautions that samplers should take for every aspect of the sampling process. The EPA also recommends that all samplers are thoroughly trained in these sampling procedures and precautions. The Water Services Training Group (WSTG) has a course on sampling procedures for the Drinking Water National Monitoring Programme (DWNMP) (***www.wsntg.ie/courses***).

2. Sampling manual

2.1 Introduction

2.1.1 | Each WSA and its laboratory (or contract laboratories) should produce a sampling manual that sets out the comprehensive sampling arrangements needed to ensure compliance with the Regulations. One member of the WSA's staff or the laboratory's staff should be designated as responsible for the production and circulation of the sampling manual, for reviewing the sampling manual periodically and for issuing

and recording receipt of amendments and additions to the sampling manual. This person should ensure that the sampling manual (and any revisions) is circulated to all appropriate members of staff who may need to use it.

2.1.2 | As a minimum the sampling manual should contain the following sections:

- the procedures and precautions to be taken when sampling for each parameter or groups of parameters;
- The pre-determined **compliance** sampling programme which includes samples from consumers' taps in the supply zones and, where appropriate, samples from water treatment works (for nitrite and turbidity and, if the WSA chooses, the other parameters set out in table 4.3 of this section). Further guidance on compliance sampling is given in paragraph 3 of this section;
- any pre-determined **operational** sampling programme to check the effectiveness of water treatment and the quality of water leaving treatment works and in service reservoirs/water towers that is not adequately covered by the **compliance** sampling programme;
- any appropriate **operational** raw water sampling programme to enable the correct treatment to be applied and adjustments of treatment processes to be made when there are changes in raw water quality. This programme should take into account any monitoring programme under the 1989 Regulations[1] (S.I. 294 of 1989) or the 2003 Regulations[2] (S.I. 722 0f 2003);
- a **compliance** monitoring strategy for pesticides see paragraph 4.2 of this section; and
- **compliance** sampling from tankers when water is supplied by tankers for drinking and food preparation instead of through the distribution network (see paragraph 5 of this section).

1 European Communities (Quality of Surface Water Intended for Abstraction of Drinking Water) Regulations 1989 (S.I. 294 of 1989)

2 European Communities (Water Policy) Regulations 2003 (S.I. 722 of 2003)

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2.2 Sampling procedures

2.2.1 | The sampling manual should set out the procedures and precautions to be adopted for each parameter or group of parameters. The table in Appendix 1 of this section gives specific guidance on the types of bottles/containers, the cleaning procedures for them, any preservatives that need to be added, storage conditions and the maximum storage period before analysis. The following is the minimum that should be included in the sampling manual:

- in respect of "non-microbiological" parameters, the:
  - types of bottles/containers/lids;
  - cleaning procedures for the bottles/containers/lids;
  - preservatives to be added to bottles;
  - type of sample (first draw, flushed etc) and the sequence for taking each sample from the sampling point;
  - storage and transport conditions for each type of sample; and
  - time allowed before analysis commences.
- in respect of microbiological parameters, the:
  - bottle type, bottle closure and bottle shelf life specification;
  - method and conditions of bottle and bottle closure sterilisation and incorporation of disinfectant neutralising reagent;
  - arrangements to avoid accidental contamination during sampling;
  - sequence of taking samples when "non-microbiological" samples are also being taken;
  - guidance for selection of taps for sampling (covering water treatment works, service reservoirs/water towers and consumers' taps) and in respect of consumers' taps any features to be avoided (such as tap inserts);
  - precautions for sampling from taps at water treatment works, service reservoirs/water towers and in consumers' premises;

- preparation, cleaning, disinfection and flushing of taps for sampling;
- storage and transport conditions and arrangements for cooling samples;
- cleaning of sample boxes;
- time limits for starting sample analysis; and
- arrangements for keeping samples cool in the laboratory if there are delays between receipt and examination;

- In respect of all samples, sampler should:
  - have a written work list showing all samples to be taken and clearly identifying compliance samples and operational samples;
  - have a log sheet that can be filed for record purposes (a specimen field log sheet is given in Appendix 2);
  - record the reasons for postponing or cancelling compliance samples on the log sheet;
  - fix securely a sample label with a unique sample number to the container – this must make clear whether it is a **compliance** sample or an **operational** sample;
  - record clearly the unique sample number, location (address/site and grid reference), date, time and sampler identification on the log sheet;
  - record clearly all field measurements and observations at the time they are made on the log sheet and make sure they are associated with the correct samples and containers; and
  - for samples to be taken from consumers' taps, the sampler should show his/her ID (identification) or otherwise establishes his/her bona fides and should advise the consumer that he/she can check the sampler's bona fides by telephoning the WSA or the laboratory.

all samples should be transported as quickly as practical to the laboratory (or contract laboratory) in a sampling vehicle that, as a minimum, meets the following advice:

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- it is clean and has adequate storage facilities for empty sample containers and for containers filled with samples;
- it has provision for keeping samples cool and for cooling samples, when necessary;
- it is not used for any purpose that might cause contamination of samples; and
- its interior and cool boxes/refrigerators are regularly cleaned and maintained.

3. Compliance sampling from consumers' taps in the distribution network (and treatment works)

3.1 Introduction

3.1.1 | Paragraph 2.1.2 of this section states that each WSA's compliance monitoring programme should be pre-determined before the start of each sampling year. The programme should set out the number of samples to be taken for each parameter, the points (a specific point such as a tap in a specific premises or a tap at one of the premises in a small area of the supply) at which the samples are to be taken and when the samples are to be taken. The Regulations require that the samples taken in each water supply zone are representative of the quality of water consumed throughout the year and are equally distributed through the supply. Effectively this means equally distributed in time and location. Samples are required to be taken from consumers' taps, but WSAs may take samples of the water leaving treatment works (or at points within the supply zone) for particular parameters if it can be demonstrated that there would be no adverse change to the measured value of the parameters concerned. WSAs are required to take samples from the water leaving treatment works for nitrite and, for surface water treatment works only, for turbidity.

3.2 Compliance sampling programme

3.2.1 | Each WSA should set out in its sampling manual its pre-determined compliance sampling programme for each year. This programme should be based on the Drinking Water National Monitoring Programme (DWNMP issued to WSAs by the Department of Environment, Heritage and Local Government (DoEHLG) in December 2004, appropriately modified from time to time to take into account changes in water supplies in the intervening period. The WSA should consult the HSE when preparing

this programme to avoid duplication of monitoring. This programme must set out the frequencies of sampling for **each parameter** or **groups of parameters** (for many parameters the frequencies will be the same) in:

- each supply zone (consumers' taps) (all parameters – unless the WSA chooses to sample specified parameters in the water leaving the treatment works – see table 4.3 in this section); and
- each water treatment works (nitrite and turbidity, the latter at surface water treatment works only) and, if the WSA chooses, the other parameters that may be sampled in the water leaving the treatment works – see table 4.3 in this section.

3.2.2 | The frequencies must be a least the minimum specified for **check monitoring** and **audit monitoring** in table B of part 2 of the Schedule to the Regulations and amplified in the tables 3.5 and 3.6 in Appendices 1 and 2 of section 3 of this Handbook. WSAs may programme for slightly higher frequencies, say about 10% higher than the minimum, so that if samples are lost or damaged or there is a problem with analysis they will still comply with the minimum frequencies. However, WSAs should not significantly over-programme for particular parameters that are easy to sample and analyse and are likely to comply with the standards as this would bias the overall picture of drinking water quality (if WSAs consider that more samples should be taken for particular parameters the **additional** samples should be regarded as **operational** samples – see sub-section 6 of this section). The samples should be programmed to be taken at regular intervals at each point (consumers' taps in supply zones and treatment works). If the sampling frequency is 52 each year, this means a sample must be taken in each week of the year, but it should not be taken on the same day in each week – the day and the timing during the day of the sample should be varied.

3.2.3 | WSAs should note that reduced frequencies can be used for the check monitoring parameters only in the following circumstances:

"Where the values of the results obtained from samples taken during the preceding two years are constant and are significantly better than the values specified in Part 1 of the Schedule, and no factor is likely to cause deterioration in the quality of the water, the number of samples specified in Table B of Part 2 of the Schedule may be reduced and the reduction shall not (except in the case of a supply where the volume distributed or produced each day within a supply zone does not exceed 100m^3) be more than 50%."

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The EPA recommends that this provision should not be applied to supplies providing between 10 and 1,000 m3/day so that the minimum check monitoring frequency for these supplies is 4 per year.

3.2.4 | Section 2 of part 2 of the schedule to the Regulations (states, in respect of the **audit monitoring parameters**, that *"All such parameters must be subject to audit monitoring unless it can be established by a sanitary authority [now a WSA], for a period of time to be determined by it, that a parameter is not likely to be present in a given supply in concentrations which could lead to the risk of a breach of the relevant parametric value."* WSAs are advised that an audit monitoring parameter may be omitted from its compliance monitoring programme for a particular supply when that parameter has not been detected in significant concentrations in the last three years' monitoring under these Regulations or the previous Regulations (SI 439 of 200). Generally, WSAs should regard a significant concentration as greater than 50% of the parametric value. WSAs may also use other appropriate evidence to justify omitting an audit monitoring parameter from its compliance monitoring programme. For example in soft water supplies where evidence from conductivity monitoring for the last three years has shown conductivities are always less than, say, 250 µS/cm, then chloride and sulphate may be omitted because their concentrations will be significantly below 250 mg/l.

3.3 Compliance sampling points

3.3.1 | WSAs or laboratories should set out the procedures and precautions to be adopted for the selection of **compliance** sampling points and for the taking of samples from each type of sampling point. The Regulations require samples to be taken from consumers' taps. They also require samples to be taken from the water leaving treatment works for turbidity and nitrite. WSAs are permitted to take samples for particular parameters from the water leaving treatment works instead of from consumers' taps if they can demonstrate that there will be no adverse change in the concentration of those parameters (see paragraph 4.3 of this section).

3.3.2 | The following is the minimum that should be included in the sampling manual regarding sampling points for compliance sampling from consumers' taps:

- a protocol for the selection of premises from which samples are to be taken. These sampling points should be pre-determined before the start of the each year. They should be selected in accordance with guidelines specified in paragraph 3.6 of this

section. The grid reference of each selected premises or alternate premises (see next bullet below) should be noted to facilitate recording of drinking water quality information on Geographic Information Systems (GIS);

- a protocol for the selection of alternate premises when access cannot be obtained to the selected premises. Similar, neighbouring premises could be chosen. Alternatively the original selection could identify precisely a small group of similar premises from which the sampler is free to choose one that access can be obtained;
- a map or maps showing the sampling locations for the year; and
- guidance on the taking of samples. Where possible for microbiological parameters samples should be taken from metal taps that have been disinfected before sampling. Where only plastic taps or mixer taps are available they should be cleaned or disinfected before sampling. All external fittings such as anti-splash devices and hoses should be removed before sampling. Internal inserts should also be removed if possible without damaging the tap. Mixer taps should be avoided if possible and only sampled if there is no other practical choice available.

3.3.3 | The following is the minimum that should be included in the sampling manual regarding sampling points for compliance sampling from the water leaving treatment works:

- the precise location of the point or points at which samples are to be taken of the water leaving each treatment works. If there is more than one point where the water leaves a treatment works, then each point should be sampled unless the WSA has evidence to show that water quality is the same at each point. The sampling point may be downstream of the treatment works (because disinfection may not be complete at the outlet of some small works) provided there is no change in water quality to that point and it is before the first consumer and any service reservoirs/water towers;
- sampling points should be reasonably accessible and uniquely labelled;
- a schematic diagram of each treatment works showing the location of each sampling point or points;

- guidance on the sampling points. All treatment works sampling points should be fitted with metal sampling taps of a hygienic design that do not have attachments or inserts and are made of materials that do not affect the concentrations of the parameters being monitored. Water should be supplied to the sampling tap through a sample line of a suitable material that should be as short as possible. These materials should meet British Standard BS6920 regarding tests for the effect on water quality (or equivalent Irish or other European standard).

3.4 Delineation of supply zones

3.4.1 | Table B of part 2 of the schedule to the Regulations, amplified in the tables 3.5 and 3.6 in appendices 1 and 2 of section 3 this handbook, sets out the minimum number of samples that must be taken for check and audit monitoring each year based on the volume of water distributed or produced each day within a supply zone. A supply zone is a geographically defined area within which water intended for human consumption comes from one or more sources and water quality may be considered as approximately uniform. **Therefore each WSA has to divide its area into supply zones for monitoring purposes**.

3.4.2 | Each WSA must delineate its supply zones towards the end of each year for the following year. These supply zones are then used to determine the sampling programme at consumers' taps for that year. Each WSA should have a written procedure that sets out how it will delineate its supply zones. The following principles should be used:

- a discrete area supplied by a single treatment works is a supply zone;
- a discrete area supplied by more than one treatment works should be sub-divided into 2 or more supply zones if there are, or could be, significant differences in water quality within the zone;
- sub-division should normally be based on features of the distribution network, leading to supply zones supplied from a service reservoir (or water tower), pumping or booster station or pressure zone;
- in areas where variations in water quality are complex or not predictable, such as conurbations, it may be necessary to use a convenient geographical boundary for each supply zone;

- temporary introduction of stand-by or emergency sources to cater for temporarily increased populations during holiday seasons should not affect delineation of water supply zones.

3.4.3 | Towards the end of each year, each WSA should review the delineation of its supply zones for the following year. However the number of changes to delineation should be kept to a minimum to facilitate year on year assessment of drinking water quality.

3.4.4 | It is recognised that WSAs may have to take temporary operational actions to maintain water supplies or deal with incidents affecting drinking water quality that may involve the introduction of water from treatment works not designated for that supply zone. Such temporary measures should not influence the annual delineation of supply zones.

3.5 Parameters sampled from consumers' taps

3.5.1 | WSAs are required to sample many parameters at the taps normally used for human consumption (consumers' taps) because their concentrations or values could be affected by the WSA's distribution network or by the condition or maintenance of the domestic distribution system within the premises or establishments. WSAs may sample some parameters at treatment works (or other point within the distribution network such as a service reservoir or water tower) if the concentrations of those parameters are not affected by the WSA's distribution network or by the condition or maintenance of the domestic distribution system within the premises or establishments. WSAs will probably find it more cost effective to take advantage of sampling for some parameters at treatment works in the larger water supplies in conurbations and towns. On the other hand, WSAs may find it more cost effective to sample all parameters at consumers' taps for small supplies.

3.5.2 | WSAs must sample the parameters specified in table 4.1 at consumers' taps because their concentrations or values could be affected by the WSA's distribution network or by the condition or maintenance of the domestic distribution system within the premises or establishments. In addition WSAs should monitor residual disinfectant on each sampling occasion for those supplies that are disinfected with a chemical disinfectant.

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Table 4.1: parameters that must be monitored at consumers' taps

Parameter number	Parameter	Comments
1	*E coli*	
2	Enterococci	
4	Arsenic	See note 1
5	Antimony	See note 1
7	Benzo(a)pyrene	
8	Bromate	Only when sodium hypochlorite is added downstream of the treatment works
10	Cadmium	See note 1
11	Chromium	See note 1
12	Copper	
17	Lead	
18	Nickel	
20	Nitrate	Because needed to satisfy formula for nitrate and nitrite
21	Nitrite	Must also be monitored in the water leaving treatment works
24	Polycyclic aromatic hydrocarbons	
25	Selenium	See note 1
27	Trihalomethanes	
29	Aluminium	
30	Ammonium	
33	Colour	
35	Hydrogen ion concentration (pH value)	
36	Iron	
37	Manganese	
38	Odour	
41	Sodium	
42	Taste	
43	Colony count at 22oC	
44	Coliform bacteria	

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Parameter number	Parameter	Comments
46	Turbidity	Must also be monitored in the water leaving treatment works for surface water supplies
	Residual disinfectant	For most supplies this will be residual chlorine

Note 1: This parameter must be monitored at consumers' taps in a supply zone unless a WSA can demonstrate for that supply zone that the parameter has not been detected at significant concentrations (more than 50% of the standard) in sufficient samples (at least 10) from consumers taps in previous years, in which case the parameter may be monitored in the water leaving the treatment works supplying that zone.

3.6 Selection of consumers' taps for sampling

3.6.1 | WSAs are required to select sample locations (consumers' taps) that are representative of the quality of water consumed throughout the year and, as far as possible, the number of samples should be distributed equally in time and location. This implies that samples taken should be distributed evenly throughout the distribution network and throughout the year. Ideally the premises at which samples are taken should be selected at random from a list of all the premises supplied. If it is practical to do so, WSAs should select the premises at random from electoral lists, postal areas or other suitable lists.

3.6.2 | If this is not practical, the WSA should map out each water supply zone and its associated water distribution network and divide it into roughly equal geographic areas (small supply zones will be a geographic area). Within each geographic area, premises should be selected for sampling for the forthcoming year from domestic dwellings, public buildings (for example but not limited to schools, hospitals and restaurants) and food production undertakings. The total number of premises selected for the year in all the geographic areas that make up the supply zone will be the sum of the number of check and audit monitoring samples required with a small excess to allow for sample breakages etc. The number of premises selected in each category should be in proportion to the numbers of domestic dwellings, public buildings and food production undertakings in the zone. For most zones the premises sampled for compliance monitoring during the year will all be different – a particular premises will not be sampled on more that one occasion during the year. However, for the small supply zones this may not be practical because of the small number of premises and gaining access. In these cases a particular premises may be sampled on more than

one occasion, but WSAs should strive to keep repeat sampling to a minimum. When a WSA has selected all the premises for sampling during the forthcoming year, it must arrange the premises in a sampling programme so that the order of visiting the premises is such that the samples are distributed evenly in time and location.

3.6.3 | If the selected premises is a normal domestic residential premises (house or flat), the sampler must take the sample from the kitchen tap in the premises as that will be the point at which the water is normally taken for human consumption. If the selected premises are in an area that the WSA considers unsafe for a "public" official such as a sampling officer to enter, the sampler should obtain a sample from similar premises close to but outside the unsafe area. If the selected premises or establishment is not a normal domestic residential premises, the sampler should ask the owner, occupiers or manager of the premises or establishment to identify the taps that are normally used for human consumption and take the sample from one of those taps. If the sampler cannot gain access to the selected premises, the sample should be taken from a similar nearby premises to which access can be obtained.

3.6.4 | WSAs must select sufficient premises or establishments in each water supply zone each year to meet the sampling frequencies specified in tables 3.5 (check monitoring parameters) and 3.6 (audit monitoring parameters) in appendices 1 and 2 of section 3 this handbook. Check monitoring samples will be taken from all the selected premises. Audit monitoring samples will be taken from a limited number of these premises. WSAs must make sure that the premises selected for audit monitoring are also evenly distributed in time and location.

3.6.5 | WSAs should note that samples from normal domestic residential premises must be taken from the kitchen tap. It is not acceptable to take compliance samples from outside taps at these premises as these will not be representative of water used for human consumption. Similarly WSAs should not take samples from taps in public conveniences as these taps should not be used for water for human consumption. WSAs may take operational samples from taps other than kitchen taps.

3.7 Sampling from the water leaving treatment works

3.7.1 | The Regulations require WSAs to monitor the parameters specified in table 4.2 in the water leaving treatment works. In addition WSAs should monitor residual disinfectant on each sampling occasion in order to check the effectiveness of disinfection when a chemical disinfectant is dosed at the treatment works.

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Table 4.2: parameters that must be sampled in the water leaving treatment works

Parameter number	Parameter	Comments
1	Nitrite	Against the standard of 0.1 mg/l
46	Turbidity	Against the indicator parameter value of 1NTU for surface water supplies only

3.7.2 | WSAs may, if they wish, monitor the parameters specified in table 4.3 in the water leaving treatment works (or at some other representative point in the water supply zone such as a service reservoir or water tower) instead of at consumers' taps because the concentrations or values for these parameters are not affected significantly by the WSA's distribution network or the domestic distribution system within premises.

Table 4.3: parameters that may be sampled in the water leaving treatment works

Parameter number	Parameter	Comments
4	Arsenic	See note 1
5	Antimony	See note 1
6	Benzene	
8	Boron	
10	Cadmium	See note 1
11	Chromium	See note 1
13	Cyanide	
14	1,2-dichloroethane	
16	Fluoride	
18	Mercury	
22	Pesticides	
23	Pesticides – Total	
25	Selenium	See note 1
26	Tetrachloroethene and trichloroethene	
31	Chloride	
32	*Clostridium perfringens* (including spores)	Only monitored for surface water supplies
34	Conductivity	
39	Oxidisability	Monitor TOC instead

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Parameter number	Parameter	Comments
40	Sulphate	
45	Total organic carbon (TOC)	Monitor instead of oxidisability
47	Tritium	
48	Total indicative dose	Assume that gross αand gross αactivities will be used to monitor total indicative dose

Note 1: This parameter can only be monitored in the water leaving the treatment works when a WSA can demonstrate for the zone supplied by that treatment works that the parameter has not been detected at significant concentrations (more than 50% of the standard) in sufficient samples (at least 10) from consumers taps in previous years.

3.7.3 | WSAs must meet the sampling frequencies specified in tables 3.5 (check monitoring parameters) and 3.6 (audit monitoring parameters) in appendices 1 and 2 of section 3 this handbook for the average volume of water produced each day by the treatment works (or the equivalent population supplied by the treatment works). Where a treatment works has more than one outlet mains and the water quality could be different in each mains because the mains are fed by different treatment streams, the WSA should sample each mains at the frequency for the average volume of water leaving each mains each day. If a WSA does not wish to sample the parameters in table 4.3 above in the water leaving treatment works, then it must sample them at consumers' taps.

3.7.4 | The sampling point for the water leaving the treatment works (works outlet) should be located so as to provide a representative sample of the water entering the distribution network. It should be downstream of all treatment processes including any contact tanks for the final disinfection process. All treatment works outlets from which samples are to be taken should be fitted with metal sampling taps of a hygienic design that do not have attachments or inserts and that are made of materials that comply with British Standard BS6920 regarding tests for the effect on water quality (or equivalent Irish or European standard). If a sample line is needed between the outlet mains and the sampling tap, it should be as short as possible and made of materials that comply with BS6920 (or equivalent Irish or European standard).

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4. Compliance sampling for specific parameters

4.1 Acrylamide, epichlorohydrin and vinyl chloride

4.1.1 | The standards for acrylamide of 0.1 µg/l, epichlorohydrin of 0.1 µg/l and vinyl chloride of 0.5 µg/l refer to the residual monomer concentration in the water as calculated according to the specifications of the maximum release from the corresponding polymer in contact with water. This is because there are not any sufficiently sensitive analytical methods to determine these parameters in drinking water at concentrations close to the standards.

4.1.2 | Acrylamide can be present in water supplies from the use of polyacrylamides as coagulant aids in water treatment and in water works sludge treatment. Epichlorohydrin can be present in water supplies from the use of polyamines as coagulants in water treatment and from epoxy resin linings of water mains and water retaining structures. Vinyl chloride can be present in water supplies from the use of unplasticised polyvinyl chloride (uPVC) pipes in water distribution networks.

4.1.3 | WSAs can assume that the standards for these three parameters are met provided that the products that contain these parameters are approved (for example by the Drinking Water Inspectorate (DWI) in England and Wales or any other equivalent European approval system pending the development of the European Acceptance Scheme (EAS)) and that the WSAs are using the products in accordance with any conditions of approval. The Drinking Water Inspectorate's latest list is posted on its website: ***http://www.dwi.gov.uk/31/soslist06.pdf***. If WSAs are using products containing these parameters that are not approved, WSAs must obtain information about the content of the parameters in the products and the leaching of the parameters from the product under the conditions of use and calculate whether the standards for these parameters are met.

4.2 Pesticides monitoring strategy

4.2.1 | The Regulations set the following standards for pesticides and related products:

- 0.03 µg/l for each of the individual pesticides aldrin, dieldrin, heptachlor and heptachlor epoxide;
- 0.1 µg/l for each other individual pesticide and related product (such as a growth regulator) and their relevant metabolites, degradation and reaction products; and

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- 0.5 µg/l for total pesticides.

Pesticides and related products are defined in the Regulations as any organic insecticide, herbicide, fungicide, nematocide, acaricide, algicide, rodenticide, slimicide and any product related to these including any growth regulator and their relevant metabolites, degradation and reaction products. The European Commission is preparing a Guidance Document on the definition and interpretation of relevant metabolites, degradation and reaction products in the context of the EC Directive 91/414/EEC concerning the placing of plant protection products on the European market. This may form the basis for the interpretation of relevant in the context of the EC Drinking Water Directive. The guidance on monitoring for pesticides in this handbook will be up-dated if necessary when the European Commission publishes its Guidance Document.

4.2.2 | Meanwhile WSAs should assume that relevant means any metabolites, degradation and reaction products that have similar pesticidal properties to the parent pesticide. WSAs should further assume that the pesticides currently in widespread use in Ireland do not have any relevant metabolites, degradation and reaction products in the context of drinking water.

4.2.3 | The Regulations state that total pesticides means the sum of all individual pesticides detected and quantified in the monitoring procedure. WSAs should assume that this means the sum of the detected concentrations of all individual pesticides and related products and any relevant metabolites, degradation and reaction products on a particular sampling occasion from a sampling point. WSAs should be aware that on a particular sampling occasion more than one sample bottle might need to be collected to enable all the individual pesticides of interest to be determined. If an individual pesticide is not detected above the limit of detection of the analytical method it is assumed to be absent.

4.2.4 | The Regulations state that samples may be taken within the supply zone (at consumers' taps) or at the treatment works for particular parameters if it can be demonstrated that there would be no adverse change to the measured value of the parameters concerned. WSAs may assume that for all individual pesticides that there is unlikely to be any significant change in concentration between the treatment works and consumers' taps and therefore they may take all samples from the treatment works if they wish.

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4.2.5 | It is not practical or necessary to monitor for every pesticide that is used within the catchment of a water source. The Regulations recognise this by noting that only those pesticides that are likely to be present in a given supply need to be monitored. To effectively implement this requirement, each WSA should develop a **monitoring strategy** for individual pesticides for each treatment works (or supply zone if the WSA decides to sample from consumers' taps) based on the likely risk of particular pesticides being present in the water source or sources from which water is abstracted for treatment at that treatment works. In developing a **monitoring strategy**, which should form part of the sampling manual, WSAs should:

- assess as far as practical which pesticides are used in significant amounts within the catchment area of each water source (information and advice should be available from the Pesticides Unit of the Department of Agriculture (***www.pcs.ie***) and local farming groups and from local authorities in respect of non-agricultural use);
- assess as far as practical on the basis of the properties and method of use of these pesticides and local catchment knowledge whether any of these pesticides are likely to reach water sources in the catchment area (information and advice should be available from the Pesticides Unit of the Department of Agriculture and local farming groups and from local authorities in respect of non-agricultural use);
- assess as far as practical when these pesticides are used to determine when they are likely to be present in the water source and therefore in the drinking water supply (information and advice should be available from the Pesticides Unit of the Department of Agriculture and local farming groups and from local authorities in respect of non-agricultural use);
- take into account the results of any monitoring for pesticides in water sources within the catchment area carried out by the WSA, the EPA and any other organisations under the Regulations S.I. 294 of 1989 or S.I. 722 of 2003;
- take into account the results of any monitoring at treatment works or in supply zones carried out under these or the previous Regulations (S.I. 439 of 2000); and
- include any individual pesticide for which a treatment process has been installed at the treatment works to remove that pesticide.

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4.2.6 | On the basis of this **monitoring strategy** each WSA should monitor the water leaving each treatment works (or in each supply zone) at at least the minimum audit monitoring frequency specified in table 3.6 of Appendix 2 of section 3 of this handbook for each of the individual pesticides identified as likely to reach a water source from which water is abstracted to that treatment works. Although the timing of audit monitoring samples for other parameters should be evenly distributed throughout the year, the EPA strongly recommends that for pesticides the samples are targeted at the times when pesticides are likely to be used. The EPA will consider taking appropriate action against a WSA that only takes samples for pesticides at times when they are unlikely to be found in water supplies.

4.2.7 | Towards the end of each calendar year each WSA should review its **monitoring strategy** for each treatment works (or each supply zone) using the above guidance. A particular pesticide may be omitted from the **monitoring strategy** if it has not been detected at significant concentrations in the water supplied from the works in the previous three years' compliance monitoring under these Regulations or the previous Regulations (S.I. 439 of 2000). A pesticide for which a treatment process has been installed should only be omitted from the **monitoring strategy** for that treatment works if the WSA can show, either from its own operational monitoring of the water source or the monitoring carried out under the Regulations S.I. 294 of 1989 or S.I. 722 of 2003 by the WSA, the EPA or other organisations on the water source, that the pesticide has not been detected in the water source for three years, provided that this monitoring was undertaken when the pesticide was most likely to be found in the water supply.

4.2.8 | WSAs and the laboratories they use should be aware that particular analytical methods for pesticides enable a suite of pesticides of similar chemical structure or properties to be determined. WSAs may continue to monitor all the pesticides in a suite even if a particular pesticide could be omitted because it had not been detected at significant concentrations in the previous three years.

4.2.9 | If at any time a WSA has any reasonable grounds for believing that a pesticide not included in its **monitoring strategy** for a particular treatment works could be present at concentrations approaching or exceeding the standard, the WSA should include that pesticide in its monitoring strategy for that works.

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4.3 Lead monitoring strategy

4.3.1 | The standard for lead is 25 µg/l until the end of 24 December 2013 and becomes 10 µg/l from the start of 25 December 2013. WSAs must be taking action now to make sure they comply with the 10 µg/l standard and the other requirements for lead by that date.

4.3.2 | Lead is included within the audit monitoring category of the Regulations to determine compliance with these standards. The number of samples taken in each water supply zone is relatively small (1 for a supply serving 5,000 population to 13 for a supply serving 500,000 population) and the results may not give a true picture of lead concentrations at consumers' taps within the zone because they can be highly variable. The results can depend on:

- the length of any lead distribution mains;
- the length of lead pipe, if any, in the WSA's part of the service connection pipe to the premises (in general the WSA owns the part of the service connection from the mains to the external stop tap located usually just outside the boundary to the premises and the owner of the property owns the part of the service connection from the stop tap to the internal stop tap within the premises);
- the length of lead pipe, if any, in the property owner's part of the service connection pipe to the premises;
- the length of lead pipe, if any, within the internal plumbing to the kitchen tap in the property;
- the presence of copper pipe work joined by lead based solder;
- the type of sample taken (random daytime, stagnation and fully flushed – the first of these types of sample is defined and explained in paragraph 4.3.3 of this section and the latter two types in paragraph 6.7 of this section);
- the time of sampling in relation to previous water use within the property (generally a sample taken following recent water use will have a lower lead concentration than a sample taken after a long period of no water use;
- the volume of sample collected; and

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- the temperature (lead concentrations are higher in summer months than in winter months.

4.3.3 | There are three main types of sample that can be taken for monitoring lead concentrations – random daytime samples used for compliance monitoring; stagnation samples used for operational monitoring; and fully flushed samples used for operational monitoring. The latter two types of sample are described in paragraph 6 on operational monitoring. A brief description of random daytime samples is given below.

- **Random Daytime Sample** – this is where the sample is taken directly from the tap normally used for drinking without flushing the tap. The sample is taken at a random time during the day and once the sampler enters the sample location he/she takes the first litre of water from the tap. The purpose of this is to replicate how people consume water during the day (i.e. at random times without flushing the tap). This type of sampling is used for **compliance monitoring** as the Regulations require that the sample be representative of the weekly average ingested by consumers and that takes account of the occurrence of peak levels that may cause adverse effects on human health.

4.3.4 | It can be assumed that a high lead concentration (above 10 µg/l) in a compliance sample taken from a consumers' tap is indicative of lead pipe work in the WSA's or owner's part of the supply pipe or in the internal plumbing. But it cannot be assumed that a low lead concentration (less than 10 µg/l) is indicative of the absence of lead pipe within the pipe work system. Thus the limited number of compliance samples taken under audit monitoring will not give an accurate picture of compliance with the lead standard in the zone nor will they assist in identifying the extent of lead pipe within the supply pipe and internal plumbing. The EPA recommends that WSA's supplement the compliance audit monitoring with operational sampling as part of **lead surveys** as described in sub-section 6 of this section and in section 6 of this handbook on procedures for non-compliances with the standards.

4.3.5 | WSAs that need to get a much better picture of **compliance with the lead standard** should increase the number of **random daytime samples** taken from consumers' taps from the small number required by the Regulations.

4.4 Radioactivity

4.4.1 | The Regulations include the following two indicator parameters of radioactivity:

- 100 Bq/l for tritium; and
- 0.1 mSv/year for total indicative dose.

However, the Regulations do not set monitoring requirements for these parameters because the Directive indicates that the frequencies, methods and locations are to be determined by a Committee set up under Article 12 of the Directive. This Committee has drafted some requirements but they have not been adopted by the European Commission.

4.4.2 | The Regulations also state that *"Drinking water need not be monitored for tritium or radioactivity to establish total indicative dose where, on the basis of other monitoring carried out, the levels of tritium or the calculated total indicative dose are well below the parametric value."*

4.4.3 | In the absence of guidance from the European Commission, the Radiological Protection Institute of Ireland (RPII) recommends that monitoring be carried out as follows:

- **Total Indicative Dose (TID)**. All water supplies of more than 1000 m^3/d should be monitored at least once every four years. As total indicative dose cannot be measured directly, samples should be screened using gross alpha and gross beta activity measurements. Where the **gross alpha** and **gross beta** activity concentrations are found to be less that 0.1 Bq/l and 1 Bq/l respectively then the sample is deemed to be in compliance with the parametric value for TID. Where either the gross alpha or gross beta concentration exceeds these screening levels, then the individual radionuclides should be measured and the TID determined in accordance with the methodology set out in the WHO Guidelines for Drinking Water (1993). If the total indicative dose is exceeded, the WSA should consult with the EPA, the RPII and the Health Service Executive (HSE) about what action, if any, needs to be taken.; and
- **Tritium**. Where a source of tritium is present in the catchment with the potential to contaminate a raw water source used for water supplies, any such supplies of more than 1000 m^3/d should be monitored at the audit monitoring frequency. Tritium concentrations should be measured directly using ultra low background liquid scintillation counting or other equivalent method.

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5. Compliance sampling from tankers

5.4.1 | The standards in the Regulations apply at the point at which water emerges from the tanker when a WSA supplies water by tanker (or similar container) instead of through the distribution network. In Ireland water supplied by tankers is only likely to happen for short periods in an emergency or when there is an incident affecting drinking water quality or when work is being carried out on the distribution network. The Regulations do not include any specific requirements for monitoring water supplied by tankers. Instead, the monitoring frequency is to be decided by the WSA concerned.

5.4.2 | WSAs are advised that when it is necessary to supply water by tanker they should fill each tanker with water that meets all the standards in the Regulations (the indicator parameter values in Table C do not have to be met but if they are not met the water must not pose a risk to health) and place a notice on each tanker advising consumers to boil water before using it for drinking and cooking. This is because the WSA cannot ensure the hygienic condition of the tap on the tanker or the containers used by consumers to collect water. If they do this, WSAs do not need to sample the water from the tanker provided the tanker is emptied and refilled within 48 hours with water that meets the standards. If the tanker is not emptied and refilled within 48 hours, the WSA should sample for E coli, pH value and conductivity. If the tanker is not emptied and refilled within 96 hours, the WSA should sample for all the parameters in the Regulations.

5.4.3 | WSAs should keep adequate records of the deployment of each tanker that include:

- the material of construction of the internal surface of the tanker (ideally it should be approved by the Drinking Water Inspectorate of England and Wales or equivalent approval system:
  - the water supply that was used to fill the tanker and the quality of that water;
  - the times the tanker was filled, emptied and refilled;
  - the results of any sampling that was necessary; and
  - the cleaning of the tanker before and after use.

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6. Operational sampling of water supplies

6.1 Introduction

6.1.1 | Paragraph 2.1.2 of this section states that each WSA should have a pre-determined **operational** sampling programme to check the quality of the raw water, the effectiveness of water treatment and the quality of water leaving treatment works and in service reservoirs/water towers that is not adequately covered by the **compliance** sampling programme. The programme should set out the number of samples to be taken for each parameter, the points at which the samples are to be taken and when the samples are to be taken. This sub-section provides guidance on the operational sampling programme, including where **on-line continuous** monitors can be used and where they must be used.

6.2 Operational sampling programme

6.2.1 | Each WSA should set out in its sampling manual its pre-determined **operational** sampling programme for each year. This programme must set out the frequencies of sampling and how quickly the result is required for **each relevant parameter** at:

- each of the raw water sources (intakes to treatment works);
- each treatment works (or each part of the treatment process);
- suitable points in each distribution network including each service reservoir/water tower; and
- at consumers' taps in particular supply zones when the WSA considers that the compliance sampling needs supplementing for particular parameters. Note that such operational samples can be taken from a "sentinel" tap, or taps, (such as an outside tap that can be sterilised) in each zone to monitor quality at the same point over time.

6.2.2 | The frequency of sampling for each parameter will depend on how variable its concentration or value is likely to be in the raw water source, during treatment, in the water leaving the treatment works and in the distribution network and its importance or significance in relation to water quality. WSAs may have to carry out additional

operational sampling in response to incidents affecting drinking water quality or in emergencies or may wish to carry out additional microbiological monitoring of the supply to ensure that contamination has not occurred.

6.3 Operational sampling points

6.3.1 | Operational samples may need to be taken from the raw water sources, from individual treatment processes, from the water leaving treatment works, from points in the distribution network such as service reservoirs and water towers and from consumers' taps.

6.3.2 | The following is the minimum that should be included in the sampling manual regarding sampling points for operational sampling from the raw water source:

- the precise location of the point at which samples of the raw water source are to be taken;
- the sampling points should be reasonably accessible and if possible uniquely labelled; and
- a schematic diagram of each raw water source showing the location of the sampling point.

6.3.3 | The following is the minimum that should be included in the sampling manual regarding sampling points for operational sampling from the treatment works:

- the precise location of the points at which samples are to be taken of the water from the treatment processes and the water leaving the treatment works;
- sampling points should be reasonably accessible and uniquely labelled;
- a schematic diagram of each treatment works showing the location of each sampling point or points; and
- guidance on the sampling points. All treatment works sampling points should be fitted with metal sampling taps of a hygienic design that do not have attachments or inserts and that are made from materials that do not affect the concentrations of the parameters being monitored. Water should be supplied to the sampling tap

through a sample line of a suitable material that should be as short as possible. The materials should meet British Standard BS6920 regarding tests for the effect on water quality (or equivalent Irish or European standard).

6.3.4 | The following is the minimum that should be included in the sampling manual regarding sampling points for operational sampling from service reservoirs and water towers and other points in the distribution network:

- the precise location of the point or points from which a representative sample or samples of the water flowing into the distribution network can be obtained. Where reservoirs/towers are divided into compartments and water does not mix freely between the compartments, the sampling points should be located so that samples are representative of all the water leaving the service reservoir/water tower or alternatively each compartment or its outlet should have a separate sampling point. Similar sampling arrangements should apply where there are two or more service reservoirs on a site;
- sampling points should be reasonably accessible and uniquely labelled;
- a schematic diagram of each service reservoir/tower or service reservoir/tower complex showing the location of the sampling point or points;
- all service reservoir/tower outlets should be fitted with metal sampling taps of a hygienic design that do not have attachments or inserts and that are made from materials that do not affect the concentrations of the parameters being monitored. Water should be supplied to the sampling tap through a sample line of a suitable material that should be as short as possible. The materials should meet British Standard BS6920 regarding tests for the effect on water quality (or equivalent Irish or European standard). Where it is impracticable to provide a tap on the reservoir site, a tap should be provided on the outlet main at the nearest possible point to the reservoir. Dip sampling should not be used. Break pressure tanks that do not provide a strategic reserve of water are not considered as service reservoirs/water towers; and
- other operational sampling points in the distribution system could be selected consumers' taps, or "sentinel" taps (such as outside taps or taps in public buildings) or hydrants depending on the purpose of the operational sampling.

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6.4 Raw water source

6.4.1 | Each WSA should have a **raw water operational sampling programme** to determine the quality of the source water to enable it to adjust and operate the treatment processes effectively. The WSA should make arrangements to be informed of the results of any sampling and analysis it or the EPA has carried out under the 1989 Regulations (S.I. 294 of 1989) or the 2003 Regulations (S.I. 722 of 2003) on the raw water source. Each WSA should also make arrangements with the EPA and other appropriate organisation to be informed of any pollution incidents that might affect adversely the quality of the water abstracted for treatment. The WSA should take this information into account when determining its own raw water sampling programme.

6.4.2 | The sampling manual should set out the parameters to be monitored, the frequency of sampling and analysis and the speed with which the results are required. Some parameters may be monitored continuously on-line with the results automatically relayed to the treatments works control room or to a remote control room for an unmanned works. Other parameters will be monitored at appropriate intervals. These will depend on the nature of the water source and the activities in the catchment that might affect water quality and the likely variations in quality. For example for a surface water source these could include conductivity, pH value, colour, turbidity and any parameters determined by a risk assessment to be important for that source (e.g. Cryptosporidium or pesticides). For a ground water source these could include conductivity and any parameters determined by a risk assessment to be important for that source (e.g. iron/manganese in aerobic ground waters). The programme should be reviewed and if necessary modified in the light of experience and the results obtained.

6.5 Treatment works

6.5.1 | Each WSA should **have a treatment works operational sampling programme** to check the overall effectiveness of the treatment processes and to check the operation of individual processes, in particular the effectiveness of disinfection and the minimisation of disinfection by-products. Sampling points for operational samples should be representative of water quality for the process to be monitored.

6.5.2 | Each WSA should specify the parameters and the frequency of sampling for each important process. Some parameters must be monitored continuously on-line (turbidity and residual chlorine) with the results automatically relayed to the treatment works control room or to a remote control room for an unmanned works and other

parameters may be monitored continuously on-line (for example pH value, conductivity, colour). Other parameters will be monitored at appropriate intervals. The parameters will depend on raw water quality and the treatment processes used and should include monitoring for those parameters that the treatment processes are designed to remove (such as microbiological, pesticides, nitrate etc). WSAs should also specify how quickly the samples should be analysed and the results sent to the operator of the treatment works. The following paragraphs give some examples for the common treatment processes.

6.5.3 | For works using coagulation the operational monitoring could include:

- jar tests to determine optimum coagulant dose and coagulation pH (or automatic coagulation controller;
- coagulant dose;
- coagulation pH;
- residual coagulant following clarification/settlement (aluminium or iron).

6.5.4 | For works using conventional filtration the operational monitoring could include:

- on-line continuous turbidity monitoring of the filtrate from each filter;
- on-line continuous turbidity monitoring of the combined filtrate from all filters; and
- pH value as it may need adjusting for efficient disinfection.

6.5.5 | For works using granular activated carbon (GAC) either as a separate filtration process or incorporated into slow sand filters, the operational monitoring will depend of the purpose of the GAC (colour removal, general organics removal or specific organics removal such as individual pesticides) and could include:

- total organic carbon (TOC);
- colour;
- turbidity; and
- specific organic compounds such as individual pesticides.

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6.5.6 | For works using chlorination as the disinfectant:

- chlorine dose;
- pH value; and
- on-line continuous monitoring of chlorine residual in the final water.

6.5.7 | For the final water before entering the distribution network for a works using the above processes the operational monitoring could include:

- coliform bacteria and E. coli;
- colony counts at 22˚C;
- on-line continuous monitoring for chlorine residual;
- on-line continuous monitoring for turbidity;
- conductivity;
- pH value;
- colour;
- aluminium or iron residual;
- fluoride (when the supply is fluoridated);
- trihalomethanes; and
- any other parameter the works is specifically designed to remove

6.6 Distribution network

6.6.1 | Each WSA should have a **distribution network operational sampling programme** to check whether there has been any contamination or deterioration of quality within the network. Often this programme will consist of sampling from service reservoirs and water towers but may also include other points within the network. Each WSA should specify the parameters and the frequency of sampling. WSAs should

also specify how quickly the samples should be analysed and the results sent to the network operator. The following paragraphs give some examples for distribution networks.

6.6.2 | For service reservoirs and water towers the operational monitoring could include:

- coliform bacteria and *E. coli*;
- colony counts at 22˚C; and
- chlorine residual.

6.6.3 | For the distribution network the operational monitoring could include, at appropriate points throughout the network that are representative of the whole network:

- chlorine residual; and
- pH value/conductivity.

6.7 Lead

6.7.1 | Paragraph 4.3 describes sampling for lead and some of the difficulties and issues with the use of random daytime samples for **compliance monitoring**. Because of this it is necessary for WSAs to carry out **operational sampling** for lead to assist in determining the extent of lead pipe work within the water supply zone, the extent of non-compliance with the lead standard and the remedial action that might be required. The two types of operational monitoring samples for lead are described below:

Stagnation sample – this is where the water is allowed to stagnate in the pipes for a set period prior to taking the sample. The water is fully flushed prior to the stagnation period. In general this period should be at least 30 minutes but to get the "worst-case" scenario the sample can be taken first thing in the morning before any taps are used (this is usually accomplished by the sampler leaving sample containers with the occupier of the house the previous day). This will give the "worst-case" scenario. This type of sampling is regarded as **operational monitoring** and should be used for lead surveys to determine where lead pipes are located (i.e. results <5 µg/l indicate no

lead pipes present). It may also be used to monitor the effectiveness of any treatment introduced to reduce plumbosolvency. Regard should be had to the location of lead in the plumbing system to ensure that the water sampled has been in contact with lead during the stagnation period.

Fully flushed sample – This is where water is fully flushed (run to waste) prior to sampling. The length of time a tap has to been run depends on several factors including length of pipe, rate of flow through the pipe and water pressure For example, if the service connection to a house is a 20 m long 1" pipe, approximately 10 L of water (i.e. a sink full) will need to be run to waste. This method determines the quality of water in the distribution network as the volume of water in the service connection and internal plumbing is run to waste. This method is used where consumers have been advised to fully flush their taps. The purpose is to confirm that the levels of lead in the fully flushed water (i.e. what is being consumed) are satisfactory. Where these levels are high it indicates that there may be a long service connection comprised of lead or there may be lead in the distribution main. The amount of water to be flushed through the system prior to sampling should be *calculated having regard to the length of lead service pipe and design of the* plumbing system.

6.7.2 | These operational samples are used as part of a **lead survey** to determine the extent of lead pipes in the distribution network, the supply pipe work (service connections) and the internal plumbing within premises. Guidance on the use of lead surveys is given in section 6 of this handbook on procedures for non-compliance with standards.

6.8 Cryptosporidium

6.8.1 | There is no regulatory requirement for WSAs to monitor for *Cryptosporidium*. Monitoring for *Cryptosporidium* requires specialist sampling equipment and a laboratory equipped for specialist analysis. The EPA Environmental Enforcement Network Cryptosporidium Working Group recommends that for an initial period of two years the following minimum monitoring frequencies are implemented:

- for treatment works serving a population greater than 20,000, once every week a sample collected continuously over 24 hours should tested for *Cryptosporidium*; and

- for treatment works serving a population less than 20,000, a sample collected continuously over 24 hours should be tested for *Cryptosporidium* at a frequency to be determined from the risk category and results of treatment works monitoring.

After two years of testing, a review of results for each water treatment works will allow the monitoring frequencies to be adapted to better suit the characteristics of each supply. The EPA regards the preparation and implementation of Drinking Water Safety Plans (DWSPs), including risk assessments for *Cryptosporidium*, as a key measure to ensuring a secure and safe drinking water supply. Comprehensive advice on preparing DWSPs and on carrying out risk assessments for *Cryptosporidium* is given in section 10 of this handbook.

6.8.2 | Where a public water supply is clearly high risk in respect of *Cryptosporidium* because there is *Cryptosporidium* in the catchment and there are insufficient treatment barriers (such as coagulation/filtration or membrane filtration) or disinfection (such as irradiation with ultraviolet (UV) light) in place to remove or inactivate *Cryptosporidium*, monitoring should be carried out to determine whether there is a risk to health. The monitoring frequency should be determined in consultation with the HSE. Where there is a treatment barrier and/or disinfection or a barrier/disinfection has been installed to remove/inactivate *Cryptosporidium*, there is a case for some operational monitoring for *Cryptosporidium* to establish that the barrier/disinfection is working satisfactorily. Similarly where there is some doubt about the accuracy of the risk assessment because there is uncertainty about the risk of *Cryptosporidium* in the catchment of the source or about the effectiveness of the barrier/disinfection, there is a case for monitoring for *Cryptosporidium* to establish/confirm the risk before installing new or additional barriers/treatment.

6.8.3 | Where a WSA decides it is necessary to monitor for *Cryptosporidium*, it should only carry out the monitoring until it has established/confirmed that there is, or is not, a risk. Where monitoring is necessary, a minimum of 40 litres per hour of water should be collected continuously from the water leaving treatment works over 24 hours in a special sampling device and tested for *Cryptosporidium* at an appropriate frequency determined in consultation with the HSE. The amount of *Cryptosporidium* in the sample is estimated using an appropriate analytical technique. Comprehensive guidance on suitable sampling devices and on appropriate analytical techniques is available on the web-site of the Drinking Water Inspectorate (DWI) for England and Wales (***http://www.dwi.gov.uk/regs/crypto/legalindex.htm***).

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7. Other types of samples

7.1 | From time to time WSAs will be required to take and analyse other samples. One example is samples taken to investigate failures to comply with the standards and indicator parameter values. Another example is samples taken in response to consumers' complaints about drinking water quality. These samples are not included in the formal **compliance** or **operational** monitoring programme. However the WSA should keep adequate records of these other types of sample and the results of any analysis so that they can be provided to the EPA on request. Sometimes consumers collect samples when they are concerned about water quality. There is no guarantee that consumers have taken these samples properly or collected them into appropriate containers. WSAs should still analyse these samples unless it is obvious that the results would be meaningless in which case the WSA should explain to the consumers why the samples are not being analysed. When WSAs do analyse samples taken by consumers, they should treat the results with caution. WSAs should also always collect and analyse their own samples when investigating consumers' complaints.

8. Training of samplers

8.1 | In order to carry out sampling correctly it is essential that all samplers are fully trained and competent before they are allowed to work unsupervised. The WSA or its laboratory (or its sampling/laboratory contractor) should produce a comprehensive sampler's training programme to cover all aspects of sampling and include:

- the criteria for selection of persons suitable to train as samplers;
- supervised training in all relevant aspects of sampling, including in the field;
- the criteria and method of assessment of competence to work supervised and unsupervised;
- the criteria and method of assessment of competence for trainers of samplers to train, audit and supervise samplers;
- the monitoring and supervision of trained samplers to check that they continue to perform satisfactorily and the criteria for satisfactory performance;
- re-training when performance is not satisfactory; and

- an annual review of each sampler's training to assess whether further training is necessary.

8.2 | Samplers should not carry out sampling procedures unless they have been successfully trained to an acceptable standard or they are being supervised by a competent and experienced sampler as part of their training. All samplers should have:

- a copy of the sampling manual;
- been trained in all the relevant procedures in, and practices of, the sampling manual that they are, or could be, required to carry out; and
- a training record that sets out clearly those procedures and practices in which they have been trained, the dates and results (competency) of that training, the dates and results of monitoring/audits of training and any re-training and the results of the annual review.

8.3 | The Water Services Training Group (WSTG) has a course on sampling procedures for the Drinking Water National Monitoring Programme (DWNMP) (***www.wsntg.ie/courses***). Other organisations may offer suitable training courses for samplers.

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Appendix 1: Sample bottles, sample preservation and storage

1. The following table gives an alphabetical list of the regulatory parameters with the recommended sample bottle types, nominal sample volumes, storage times and preservatives. This information is based largely on International Standard ISO 5667-3:2004 "Water Quality – Sampling – Part 3: Guidance on the preservation and handling of water samples".

2. While the information in the table is generally applicable, it should be remembered that analytical techniques are continually evolving and undergoing improvement. It may therefore be the case that for some of the parameters for which large volumes in specially cleaned glass bottles are prescribed, that smaller quantities would be acceptable to the laboratory and the analyst. Samples for several parameters can be collected in the same sample bottle with the same preservative.

3. While the recommendations represent an ideal situation the logistics of sample collection and transport may mean that it is impractical to meet these recommendations. Where this is the case alternative recommendations are presented. For microbiological parameters it is imperative that time delay between sampling and analysis is kept to a minimum.

4. Where extended storage times are utilised it is recommended that laboratories verify the validity of such approaches by conducting storage recovery tests. Analytical measurements should be subject to appropriate Analytical Quality Control (Refer to International Standard ISO/TS 13530:2009 "Water quality – Guidance on analytical quality control for chemical and physicochemical analysis") and sample bottles used should be assessed for possible contamination.

5. In case of any doubt the laboratory or the analysts should be consulted prior to sampling.

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Key to the table

ASAP: Analysis as soon as possible (on-site or within a maximum of 24 hours)

D: Maximum recommended storage time after preservation (if applicable)

Glass*: Glass bottle rinsed with 5% HNO3

Glass+: Glass bottle rinsed with suitable solvents.

IA: Immediate analysis

P/G: Plastic or glass

P/G-AW: Plastic or glass – acid washed (e.g. 5% v/v HNO3)

R: Refrigerate at 1-5˚C

RD: Refrigerate in the dark

Sterile: Pre-sterilised container

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Parameter		Bottle Type	Bottle Volume	Preservation and storage conditions	Storage Period after preservation[1]
29	Aluminium	P/G-AW	250 ml	Acidify with HNO_3 to pH 1-2	1month[6]
30	Ammonium	P/G	500 ml	ASAP R Acidify with H_2SO_4 to pH <2 Freeze to – 20˚C	< 2 hours 24 hours 21 days 1 month
4	Antimony	P/G-AW	100 ml	Acidify with HNO_3 to pH 1-2	1 month[2,6]
5	Arsenic	P/G-AW	500 ml	Acidify with HNO_3 to pH 1-2	1 month[2,6]
6	Benzene	Glass+	2500 ml	R, do not pre-rinse bottle with sample	7 days
7	Benzo(a)pyrene	Glass+	2500 ml	R, do not pre-rinse bottle with sample	7 days
8	Boron	Plastic	100 ml	Acidify with HNO_3 to pH 1-2	1 month
9	Bromate	P/G	100 ml	R	1 month
10	Cadmium	P/G-AW	100 ml	Acidify with HNO_3 to pH 1-2	1 month[6]
31	Chloride	Plastic	100 ml	R	1 month
11	Chromium	PG-AW	100 ml	Acidify with HNO_3 to pH 1-2	1 month[6]
32	*Clostridium perfringens*	G/P Sterile	200 ml	Store in cooler box, 2-8˚C	6 hours[7]
44	Coliform bacteria	G/P Sterile	200 ml	Store in cooler box, 2-8˚C	6 hours[7]
43	Colony count 22˚C	Glass S	200 ml	Store in cooler box, 2-8˚C	6 hours[7]
33	Colour	Plastic	250 ml	RD	5 days[3]
34	Conductivity	Plastic	100 ml	R	7 days[4]
12	Copper	P/G-AW	100 ml	Acidify with HNO_3 to pH 1-2	1 month
13	Cyanide	Plastic	500 ml	Add NaOH to pH>12; RD	7 days

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Parameter		Bottle Type	Bottle Volume	Preservation and storage conditions	Storage Period after preservation[1]
14	1,2-Dichloroethane	Glass+	2500 ml[9]	R; if residual chlorine is present add 80 mg $Na_2S_2O_3$ per litre of sample	14 days
2	Enterococci	G/P Sterile	200 ml	Store in cooler box, 2-8˚C	6 hours[7]
1	Escherichia coli [E.coli]	G/P Sterile	200 ml	Store in cooler box, 2-8˚C	6 hours[7]
16	Fluoride	Plastic	500 ml	R	1 month
35	Hydrogen ion concentration (pH)	Plastic	100 ml	IA (on-site if possible and preferably within 6 hours	6 hours[5]
36	Iron	P/G-AW	100 ml	Acidify with HNO_3 to pH 1-2	1 month[6]
17	Lead	P/G-AW	100 ml	Acidify with HNO_3 to pH 1-2	1 month[6]
37	Manganese	P/G-AW	100 ml	Acidify with HNO_3 to pH 1-2	1 month[6]
18	Mercury	Glass*	500 ml	Acidify with HNO_3 to pH 1-2 Add 0.05%w/v K_2CrO_7; R	1 month
19	Nickel	P/G-AW	50 ml	Acidify with HNO_3 to pH 1-2	1 month[6]
20	Nitrate	P/G	100 ml	Add H_2SO_4 to pH<2; R	48 hours
21	Nitrite	Plastic	100 ml	R Acidify with HCl to pH <2 Freeze to – 20˚C	24 hours 7 days 1 month
38	Odour	Glass	500 ml	ASAP, R	6 hours
39	Oxidisability	P/G	500 ml	Acidify with 8M H_2SO_4 to pH 1-2 Refrigerate at 1-5˚C Freeze to – 20˚C	2 days 2 days 1 month
22	Pesticides	————	See pesticides – Total – ————-		

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Parameter		Bottle Type	Bottle Volume	Preservation and storage conditions	Storage Period after preservation[1]
23	Pesticides – Total	Glass+	2500 ml	R; do not pre-rinse bottle with sample; if residual chlorine is present add 80 mg $Na_2S_2O_3$ per litre of sample	5 days[8]
24	Poly aromatic hydrocarbons	Glass+	2500 ml	R; do not pre-rinse bottle with sample; if residual chlorine is present add 80 mg $Na_2S_2O_3$ per litre of sample	7 days[8]
25	Selenium	P/G-AW	100 ml	Acidify with HNO_3 to pH 1-2	1 month[6]
41	Sodium	P/G	100 ml	Acidify with HNO_3 to pH 1-2 if by atomic spectrometry R; if by ion chromatography	1 month[6] 1 month
40	Sulphate	P/G	200 ml	R	14 days
42	Taste	Glass	500 ml	ASAP; R	24 hours
26	Tetrachlorethene and trichlorethene	Glass+	2500 ml9	R; if residual chlorine is present add 80 mg Na2S2O3 per litre of sample	14 days
45	Total organic carbon [TOC]	P/G	150 ml	R Freeze to – 20˚C	7 days 1 month
27	Trihalomethanes – Total	Glass+	250 ml9	R; if residual chlorine is present add 20 mg $Na_2S_2O_3$ per 250 ml of sample	14 days
46	Turbidity	Plastic	500 ml	Store in dark <24 hours	24 hours

[1] Though the storage period for preserved samples may be up to one month for some parameters, it is recommended that analysis for drinking water parameters be carried out within at least 14 days of the sample being taken.

[2] HCl should be used if the hydride technique is used for this analysis.

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[3] Samples should be kept in the dark. In the case of groundwater rich in iron II analysis should preferably be carried out on site within 5 minutes of collection to avoid precipitation of Iron oxides.

[4] Analysis within 24 hours is recommended in the ISO standard. However, if no significant changes are likely samples can be analysed within 7 days.

[5] In-situ pH measurements should be made using instruments calibrated before use. While laboratory measurements are generally more accurate the actual pH of samples (particularly lime-treated waters) could change during transport to the laboratory and stability may require to be verified. Samples should be kept cool and laboratory analysis commenced within 24 hours.

[6] Samples for metal analysis should preferably be analysed within 1 month but may be stored up to 6 months if recovery after extended storage has been validated.

[7] Samples for microbiological parameters should be kept in the dark refrigerated during transportation to the laboratory. If samples are kept at ambient temperature (in the dark, not exceeding 25˚C) the examination shall begin within 6 h after taking the sample. Samples may be kept at (5 ± 3˚C) for up to 24 h prior to examination however the time between sampling and examination must be kept to a minimum. Refer to ISO 9308-1:2000 for further details.

[8] Extraction for Pesticides/PAHs should ideally be undertaken within 24 hours. The preservation time given is for the extracted sample.

[9] Analysis for organics by purge/trap or GCMS techniques may require as little as 40 ml (in duplicate). Check with the laboratory or analyst before sampling.

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Appendix 2: Specimen field log sheet

European Communities (Drinking Water) (No. 2) Regulations 2007

Water Services Authority:
[A separate sheet for each supply to be completed at the time of sampling]

Date of sample:
Name of sampler:
Name of water supply:
Full details of sampling point and its location:
Sample identification:
Time of Sampling:
General observations:
Results of Field Measurements:
Conductivity: µS/cm
pH value: pH units
Temperature: o C
Total chlorine: mg/l
Free chlorine: mg/l
Others:

Details of samples taken

Bottle No	Bottle type	Bottle volume	Preservation details	Comments
1				
2				
3				
4				
5				
etc				

Observations:
Signature of sampler:
Sample received in the laboratory at (time and date):
By:
From:

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