

SECTION 3: MONITORING OF DRINKING WATER QUALITY



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Section 3: Monitoring of drinking water quality

Summary of Section 3

- ◆ Describes the difference between mandatory “compliance monitoring” carried out by Water Services Authorities (WSAs) and non-mandatory “operational monitoring” carried out by private water suppliers.
- ◆ Sets out and describes the parameters included in the compliance monitoring categories of check monitoring and audit monitoring.
- ◆ Sets out the monitoring frequencies (number of samples) for the check monitoring and audit monitoring parameters.
- ◆ Sets out the requirement for a pre-determined compliance monitoring programme and describes the relationship with the Drinking Water National Monitoring Programme (DWNMP).
- ◆ Describes the general requirement for a separate non-mandatory operational monitoring programme.

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1. Introduction

1.1 | There are two types of monitoring of drinking water quality. The first type is **mandatory “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 **non-mandatory “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 networks.

1.2 | Regulation 7(2) requires **Water Services Authorities (WSAs)** to carry out the **compliance monitoring** of private water supplies in their functional areas. This compliance monitoring programme should be pre-determined before the beginning of the monitoring year. When preparing its programme the WSA should consult with the private water supplier to make sure that the premises selected for monitoring are supplied by the private water supply. The WSA should also consult the HSE when preparing the programme to avoid duplication of monitoring. The WSA should notify the private water supplier of the results of that monitoring as soon as practical after the results are available.

1.3 | Although it is not a requirement of the Regulations, it is strongly recommended that **private water suppliers** have a separate pre-determined **operational monitoring programme** to check the operation of their treatment works and distribution networks. 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.

2. Compliance monitoring

2.1 Monitoring categories

2.1.1 | The Regulations specify two categories of mandatory compliance monitoring – **check monitoring** and **audit monitoring** – to determine compliance with the standards and indicator parameter values in the Regulations. Check monitoring is carried out relatively frequently for a limited range of parameters. Audit monitoring is carried less frequently for **all** the parameters including those subject to check monitoring. This

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means that for some parameters the monitoring frequency is the sum of the check and audit monitoring frequencies. **Check monitoring** and **audit monitoring** on private water supplies is carried out by **WSAs**, not the private water suppliers.

2.2 Check monitoring parameters

2.2.1 | 2.2.1 Part 2 of the schedule to the Regulations states “*The purpose of check monitoring is regularly to provide information on the organoleptic and microbiological quality of the water supplied for human consumption as well as information on the effectiveness of drinking-water treatment (especially of disinfection) where it is used, in order to determine whether or not water intended for human consumption complies with the relevant parametric values laid down in Part 1 of this Schedule.*” The term “organoleptic” means the properties and parameters of water that can be detected by the sensory organs such colour, taste and odour

2.2.2 | 2.2.2 The parameters set out in table 3.1 are subject to check monitoring. Some of these parameters are always included in check monitoring whilst others are only included when the specified circumstances described in the notes exist. If the specified circumstances do not exist the parameter must be included in audit monitoring. The notes in italics are quoted directly from the schedule to the Regulations.

Table 3.1: parameters subject to check monitoring

Parameter number	Parameter	Notes (specified circumstances)
29	Aluminium	<i>Necessary only when used as a flocculant (coagulant)</i>
30	Ammonium	
32	<i>Clostridium perfringens</i> (including spores)	Only need be measured if the water originates from or is influenced by surface water
33	Colour	
34	Conductivity	
1	<i>Escherichia coli [E.coli]</i>	
35	Hydrogen ion concentration	
36	Iron	<i>Necessary only when used as a flocculant (coagulant)</i>
21	Nitrite	Necessary only when chloramination is used as a disinfectant
38	Odour	
42	Taste	

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Parameter number	Parameter	Notes (specified circumstances)
44	Coliform bacteria	
46	Turbidity	

2.3 Audit monitoring parameters

2.3.1 | Part 2 of the schedule to the Regulations states *“The purpose of audit monitoring is to provide the information necessary to determine whether or not all the parametric values specified in Part I of this Schedule are being complied with. All such parameters must be subject to audit monitoring unless it can be established by a sanitary authority [now called 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. This paragraph does not apply to the parameters for radioactivity, which, subject to Notes 6, 7 and 8 in Table C in Part 1 of the Schedule will be monitored in accordance with monitoring requirements adopted under the Committee procedure set out in Article 12 of Council Directive 98/83/EC.”*

2.3.2 | The Regulations require that all parameters are subject to audit monitoring unless it can be shown that a parameter is unlikely to be present. This means that some parameters are subject to both check and audit monitoring for the same supply. For these particular parameters, the monitoring frequency is the sum of the check and audit monitoring frequencies. This is particularly important for private water supplies that are monitored infrequently as it means extra surveillance of their quality, particularly microbiological quality.

2.3.3 | The European Commission has not yet promulgated requirements on monitoring for the radiological parameters, tritium and total indicative dose. In the meantime and in order to acquire information about the presence of radioactivity in Irish drinking water supplies, it is recommended that WSAs include the radiological parameters in audit monitoring. Guidance on monitoring for radiological parameters is given in Section 4, paragraph 4.4.

2.3.4 | Table 3.2 sets out the parameters subject to audit monitoring. Some of these parameters are only included in audit monitoring if the specified circumstances exist. If they do not exist those parameters must be included in check monitoring. Note that it is not possible to analyse for certain parameters and they must be controlled by product specification (see notes to table 2.2 in section 2).

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Table 3.2: parameters subject to audit monitoring

Parameter number	Parameter	Specified circumstances
Microbiological parameters		
2	Enterococci	
Chemical parameters		
3	Acrylamide	Analysis not practical. Controlled by product specification.
4	Antimony	
5	Arsenic	
6	Benzene	
7	Benzo(a)pyrene	
8	Boron	
9	Bromate	
10	Cadmium	
11	Chromium	
12	Copper	
13	Cyanide	
14	1,2-Dichloroethane	
15	Epichlorohydrin	Analysis not practical. Controlled by product specification.
16	Fluoride	
17	Lead	
18	Mercury	
19	Nickel	
20	Nitrate	
21	Nitrite	When chloramination is not used as the disinfectant
22	Pesticides	
23	Pesticides – total	
24	Polycyclic aromatic hydrocarbons	
25	Selenium	
26	Tetrachloroethene and trichloroethene	
27	Trihalomethanes - total	

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Parameter number	Parameter	Specified circumstances
28	Vinyl chloride	Analysis not practical. Controlled by product specification.
Indicator parameters		
29	Aluminium	Only when not used as a flocculant (coagulant)
31	Chloride	
32	<i>Clostridium perfringens</i> (including spores)	Only when the water does not originate from surface water or is not influenced by surface water
36	Iron	Only when not used as a flocculant (coagulant)
37	Manganese	
39	Oxidisability	Monitor TOC instead
40	Sulphate	
41	Sodium	
43	Colony count 22°C	
45	Total organic carbon (TOC)	Monitor instead of oxidisability
[47]	[Tritium]	Include pending advice from European Commission
[48]	[Total indicative dose]	Include pending advice from European Commission

2.4 Summary of check and audit monitoring parameters

2.4.1 | Table 3.3 sets out for ease of reference a summary of the check and audit monitoring parameters by parameter category and monitoring category. This takes into account the comments and recommendations made in sub-sections 2.2 and 2.3 above.

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Table 3.3: summary of check and audit monitoring parameters

Parameter		Parameter category			Monitoring category	
No.		Microbio-logical	Chemical	Indicator	Check	Audit
1	Escherichia coli (<i>E. coli</i>)	Yes			Yes	Yes
2	Enterococci	Yes				Yes
3	Acrylamide		Yes			
4	Antimony		Yes			Yes
5	Arsenic		Yes			Yes
6	Benzene		Yes			Yes
7	Benzo(a)pyrene		Yes			Yes
8	Boron		Yes			Yes
9	Bromate		Yes			Yes
10	Cadmium		Yes			Yes
11	Chromium		Yes			Yes
12	Copper		Yes			Yes
13	Cyanide		Yes			Yes
14	1,2-Dichloroethane		Yes			Yes
15	Epichlorohydrin		Yes			
16	Fluoride		Yes			Yes
17	Lead		Yes			Yes
18	Mercury		Yes			Yes
19	Nickel		Yes			Yes
20	Nitrate		Yes			Yes
21	Nitrite		Yes		Yes*	Yes*
22	Pesticides		Yes			Yes
23	Pesticides – Total		Yes			Yes
24	Polycyclic aromatic hydrocarbons		Yes			Yes
25	Selenium		Yes			Yes
26	Tetrachloroethene and Trichloroethene		Yes			Yes
27	Trihalomethanes – Total		Yes			Yes
28	Vinyl chloride		Yes			

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Parameter		Parameter category			Monitoring category	
No.		Microbio-logical	Chemical	Indicator	Check	Audit
29	Aluminium			Yes	Yes*	Yes*
30	Ammonium			Yes	Yes	Yes
31	Chloride			Yes		Yes
32	<i>Clostridium perfringens</i> (including spores)			Yes	Yes*	Yes*
33	Colour			Yes	Yes	Yes
34	Conductivity			Yes	Yes	Yes
35	Hydrogen ion concentration			Yes	Yes	Yes
36	Iron			Yes	Yes*	Yes*
37	Manganese			Yes		Yes
38	Odour			Yes	Yes	Yes
39	Oxidisability			Yes		
40	Sulphate			Yes		Yes
41	Sodium			Yes		Yes
42	Taste			Yes	Yes	Yes
43	Colony count 22°C			Yes		Yes
44	Coliform bacteria			Yes	Yes	Yes
45	Total organic carbon (TOC)			Yes		Yes
46	Turbidity			Yes	Yes	Yes
47	Tritium			Yes		Yes
48	Total indicative dose			Yes		Yes

*These parameters can be either check or audit monitoring depending on the circumstances

2.5 Monitoring frequencies

2.5.1 | WSAs are required to monitor each of the private water supplies in their functional areas to determine compliance with the standards and indicator parameters at the minimum frequencies set out in table B of part 2 of the schedule to the Regulations for the check monitoring and audit monitoring parameters. A large private water supply may be divided into supply zones in which the water quality is regarded

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as being approximately the same (see section 4 of this handbook). The monitoring frequencies are based on the volume of water distributed or produced each day within a supply zone. If the volume distributed or produced is not known, WSAs may use the population supplied within a supply zone assuming 1,000 m³/day supplies 5,000 population. For small supplies (most of the private water supplies) the frequencies are not specified and are to be determined by the WSAs, subject to any guidance from the Environment Protection Agency (the EPA). Such guidance is given in section 4 of this handbook based on the use of risk assessments to determine the parameters most at risk of failing to comply.

2.5.2 | WSAs must take the samples from private water supplies at the points of compliance defined in regulation 5. This requires that for water supplied through a distribution network samples must be taken from the tap or taps in premises where the water is used for human consumption. This means the kitchen tap (consumer's tap) in normal domestic premises and any appropriate tap (kitchen tap or other tap where water is used for drinking) in premises that are used for commercial or public activities. However, the Regulations allow WSAs to take samples for particular parameters from within the supply zone (for example at a service reservoir) or from the water leaving the treatment works instead of from consumers' taps if they can demonstrate that there would be no adverse change to the measured value of the parameters concerned. This could apply to a **"Public" Group Water Scheme (PuGWS)** where the treated water is provided by the WSA but responsibility for distribution of the treated water rests with the private water suppliers as well as to a **"Private" Group Water Scheme (PrGWS)** and **other private water supplies** where water is treated and distributed by the private water supplier.

2.5.3 | The check monitoring frequencies may be reduced by up to 50% in certain specified circumstances. Particular parameters may be excluded from audit monitoring if a WSA can demonstrate for those parameters that they are unlikely to be present in a water supply. Guidance on how this may be demonstrated is given in section 4 of this handbook.

2.5.4 | Table 3.4 sets out the minimum monitoring frequencies per year for various sizes of supply zone based on table B of part 2 of the schedule to the Regulations. The notes associated with that table are reproduced in italics with further amplification or explanation in normal type.

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Table 3.4: minimum frequency of sampling at consumers' taps in the distribution network

Volume of water distributed within a supply zone (m ³ /d) (Notes 1 and 2)	Number of samples per year	
	Check monitoring (Notes 3, 4 and 5)	Audit monitoring (Notes 3 and 5)
< 10*	Note 6	Note 6
≥ 10 - ≤ 100	2	Note 6
> 100 - ≤ 1,000	4	1
> 1,000 - ≤ 10,000	4 + 3 for each 1,000 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

*Only where water is supplied as part of a commercial or public activity.

Note 1: 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 being approximately uniform. See section 4 of this handbook for definition of a supply zone.

Note 2: The volumes are calculated as averages taken over a calendar year. 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 l/day/capita. This means 1,000 m³/d supplies a population of 5,000.

Note 3: In the event of intermittent short-term supply the monitoring frequency of water distributed by tankers is to be decided by the sanitary authority [WSA] concerned. See section 4 of this handbook for advice on sampling from tankers.

Note 4: 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 100m³) be more than 50%.

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Note 5: As far as possible, the number of samples should be distributed equally in time and location. The EPA advises that the premises at which samples should be taken should be selected at random from all the premises in a supply zone in accordance with the advice in section 4 of this handbook.

Note 6: To be determined by the sanitary authority [WSA], subject to any relevant guidance issued by the Agency [the EPA]. The EPA's guidance is set out in section 2.6 below.

2.5.5 | The frequencies of compliance monitoring set out above are the **minimum** frequencies and, while they are the lowest permissible, they should afford, in normal circumstances, sufficient degree of protection of drinking water quality. However there may be circumstances when increased frequencies for particular parameters in particular supplies may be necessary such as:

- ◆ past monitoring has indicated quality problems;
- ◆ there is a significant degree of variability in the concentrations of parameters;
- ◆ there is a perceived risk to the supply; and
- ◆ the EPA has granted an authorised departure from a standard (see section 6 of this handbook).

2.6 Monitoring of small private water supplies of $\leq 100 \text{ m}^3/\text{d}$

2.6.1 | The Regulations require check monitoring at a frequency of 2 per year for the check monitoring parameters for supplies between $\geq 10 - \leq 100 \text{ m}^3/\text{d}$ but do not specify a frequency for audit monitoring. The Regulations also apply to private water supplies of less than $10 \text{ m}^3/\text{day}$ that are part of a public or commercial activity but do not specify check or audit monitoring frequencies for these supplies. The Regulations require the frequency of monitoring for these small supplies to be determined by the WSA taking into account guidance from the EPA. This sub-section sets out the EPA guidance.

2.6.2 | Sampling and analysis, even once per year, for a whole range of parameters that are unlikely to be present in small private water supplies is not an effective use of resources. Therefore the EPA recommends that for each of these small supplies the WSA, in consultation with the private water supplier, carries out a risk assessment (see

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Section 10 of this Handbook) taking into account the nature of the catchment, the activities in the catchment and any treatment provided to decide whether any of the parameters are likely to be present in the supply.

2.6.3 | For audit monitoring of private water supplies between $\geq 10 - \leq 100$ m³/d, the WSA should monitor any parameters identified in the risk assessment that are not included in the check monitoring at a frequency of 2 per year (in other words add them to the list of check monitoring parameters).

2.6.4 | For check and audit monitoring of private water supplies of less than 10 m³/d that are supplied as part of a public or commercial activity, the WSA should monitor any parameters identified in the risk assessment at a frequency of 2 per year (in other words combine the check and audit monitoring for a limited number of parameters).

2.7 Check monitoring frequencies

2.7.1 | Table 3.4 shows how the monitoring frequencies (number of samples) increases with increasing volume of water supplied, but it does not readily allow WSAs to determine the frequencies required for a given size of supply. Appendix 1 expands the check monitoring frequency table (table 3.5) to cater for the entire spectrum of volumes supplied and population served for Irish private water supplies (assumes the largest private water supply is less than 5,000 m³/d, less than 25,000 population). The notes associated with table 3.4 still apply.

2.8 Audit monitoring frequencies

2.8.1 | Table 3.4 shows how the monitoring frequencies (number of samples) increases with increasing volume of water supplied, but it does not readily allow WSAs to determine the frequencies required for a given size of supply. Appendix 2 expands the audit monitoring frequency table (table 3.6) to cater for the entire spectrum of volumes supplied and population served for Irish private water supplies (assumes the largest private water supply is less than 5,000 m³/d, less than 25,000 population). The notes associated with table 3.4 still apply. For supplies of > 100 to $\leq 1,000$ m³/d (serving > 500 to $\leq 5,000$ people), the minimum audit monitoring frequency is 1 per year and it is recommended that WSAs increase this to a minimum of 2 per year.

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2.9 The Drinking Water National Monitoring Programme

2.9.1 | Each WSA should prepare, before the beginning of each calendar year, its pre-determined compliance monitoring programme for that year for each private water supply in its functional area. This programme should set out for each water supply zone the check monitoring and audit monitoring parameters, the frequency of monitoring for each parameter, the randomly selected premises at which samples are to be taken (or the treatment works if sampling for particular parameters is permitted there) and the timing of the samples during the year.

2.9.2 | The Drinking Water National Monitoring Programme (DWNMP) issued in December 2004 by DoEHLG under circular letter, reference WSP11/04, and was the basis of the pre-determined compliance monitoring programme. It set out the monitoring frequencies for all the parameters in the Regulations for each of the then identified supply zones and treatment works for each private water supply in each sanitary authority, now WSA. The DWNMP included all the PuGWS and PrGWS but may not have included all the other relevant private water supplies. The DWNMP was based on the check and audit monitoring frequencies described in the above sub-sections. The DWNMP is still valid although WSAs may have identified some additional private water supplies and they may have made some changes to private water supply schemes, such as some schemes being adopted by WSAs as public water supplies and some amalgamations of schemes.

3. Operational monitoring

3.1 | Although it is not a requirement of the Regulations, it is recommended best practice that **each private water supplier** should consider having an **operational monitoring programme** for each of its raw water sources, treatment works and associated distribution networks as part of its Quality Assurance System (such as the Hazard Analysis Critical Control Point (HACCP) based system advocated by the National Federation of Group Water Schemes, (NFGWS). This operational monitoring programme is entirely separate from the mandatory compliance monitoring programme undertaken by the WSA.

3.2 | It is recognised that there may be practical and resources difficulties for private water suppliers, particularly in respect of small supplies, to maintain an operational monitoring programme. However, those private water supplies that are “Public” Group Water Schemes and “Private” Group Water Schemes, including schemes with

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Design, Build and Operate (DBO) contracts in place, (see definitions in Section 1 of this Handbook), should have an operational monitoring programme. Smaller private water suppliers should endeavour to have an operational monitoring programme for the key (most risky) parts of their supply operation.

3.3 | Operational monitoring is sampling and analysis carried out 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 networks. At a modern treatment works many of the operational parameters will be monitored continuously or very frequently by instrumentation. These instruments will have alarm levels linked to the treatment works control room (if there is one), or for an unmanned works linked by telemetry to a remote control room (if there is one), or more likely an automatic dial up to an operator cascade system, so that rapid action can be taken when there is deterioration in performance.

3.4 | In general where a private water supplier has an operational monitoring programme in place it should consist of the following elements:

- ◆ monitoring of the source water for parameters that provide a general indication of water quality, which if their concentration or value changed significantly would indicate that there could be deterioration in source water quality. It should also include any parameters that the treatment works is specifically designed to remove;
- ◆ monitoring of the coagulation, settlement and filtration processes for those parameters that provide evidence of the effectiveness of treatment such as jar tests for optimum coagulation conditions, coagulant residual, pH value and turbidity;
- ◆ monitoring of the disinfection process for those parameters that provide evidence of the effectiveness of disinfection such as chlorine residual, pH value and microbiological parameters;
- ◆ monitoring of the water leaving the treatment works for parameters that the works is designed to remove that are not adequately monitored by the WSA's compliance monitoring such as nitrate if nitrate removal is practised; and
- ◆ monitoring within the distribution network for parameters that provide evidence that there is no deterioration or contamination within distribution that are not adequately monitored by the compliance monitoring such as chlorine residual.

3.5 | Further guidance on operational monitoring is given in section 4 of this handbook.

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Appendix 1: Check monitoring frequencies

Table 3.5: minimum frequency of sampling at consumers taps in the distribution network

Volume of water distributed within a supply zone (m ³ /d)	Equivalent population served	Check monitoring Number of samples per year
< 10	< 50	2 (see section 2.6)
≥ 10 - ≤ 100	≥ 50 - ≤ 500	2
> 100 - ≤ 1,000	> 500 - ≤ 5,000	4
> 1,000 - ≤ 2,000	> 5,000 - ≤ 10,000	10
> 2,000 - ≤ 3,000	> 10,000 - ≤ 15,000	13
> 3,000 - ≤ 4,000	> 15,000 - ≤ 20,000	16
> 4,000 - ≤ 5,000	> 20,000 - ≤ 25,000	19

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Appendix 2: Audit monitoring frequencies

Table 3.6: minimum frequency of sampling at consumers taps in the distribution network

Volume of water distributed within a supply zone (m ³ /d)	Equivalent population served	Audit monitoring Number of samples per year
< 10	< 50	2 (see section 2.6)
≥ 10 - ≤ 100	≥ 50 - ≤ 500	2 (see section 2.6)
> 100 - ≤ 1,000	> 500 - ≤ 5,000	1
> 1,000 - ≤ 3,300	> 5,000 - ≤ 16,500	2
> 3,300 - ≤ 5,000	> 16,500 - ≤ 25,000	3

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