guardians of drinking water quality
DRINKING WATER INSPECTORATE

Information Leaflets

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Tap Water

Where does it come from and how is it made safe to drink?

Contents

Where does my tap water come from?

In England and Wales, two thirds of drinking water comes from surface water, including reservoirs, lakes and rivers, and the rest from ground waters. The latter come from aquifers, which are underground geological formations that store rainwater. The rainwater seeps through porous strata such as sandstone and chalk. Water companies drill wells or bore holes into aquifers and draw water from them.

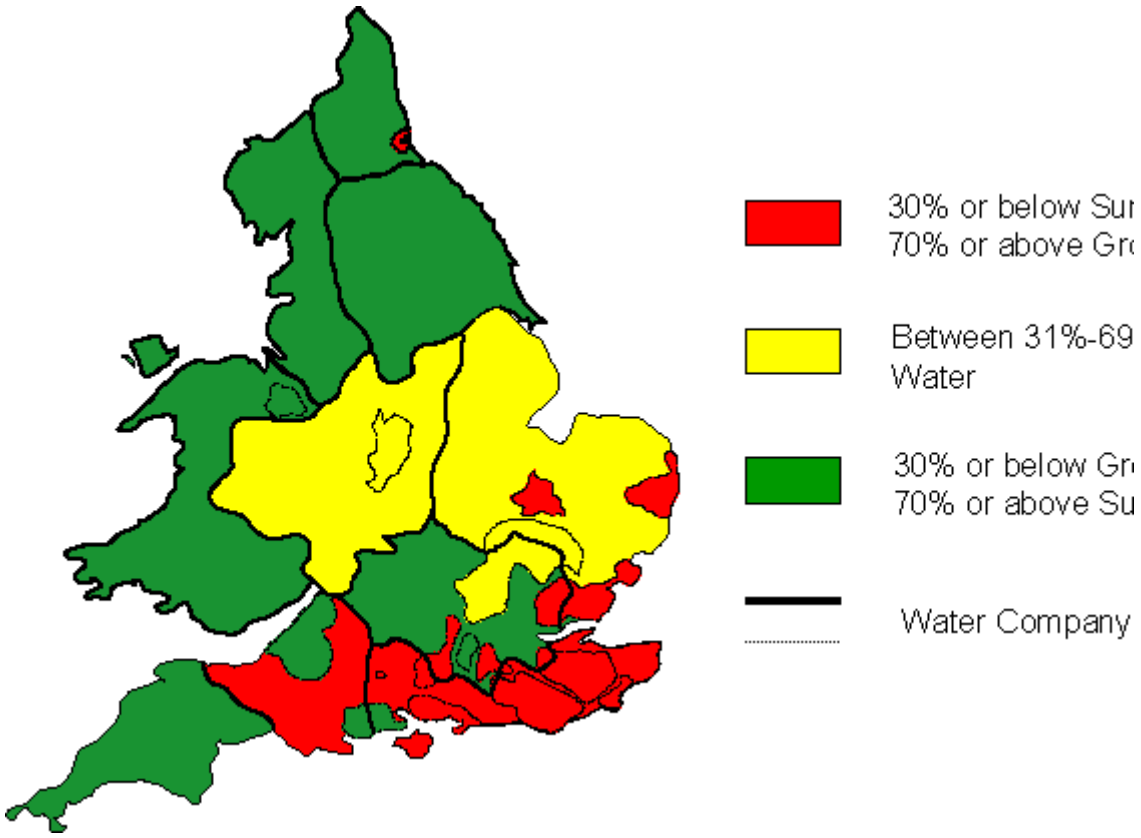
Major cities are usually supplied from the larger volume surface waters, whereas ground waters supply smaller populations, although this is not always the case. There are also areas that receive water from a mixture of sources.

Water is treated at water treatment works before flowing through water mains, sometimes over considerable distances, to arrive at your home. Samples are taken at each stage of treatment and distribution along the way,

and tested by the water company to make sure that you receive high quality water.

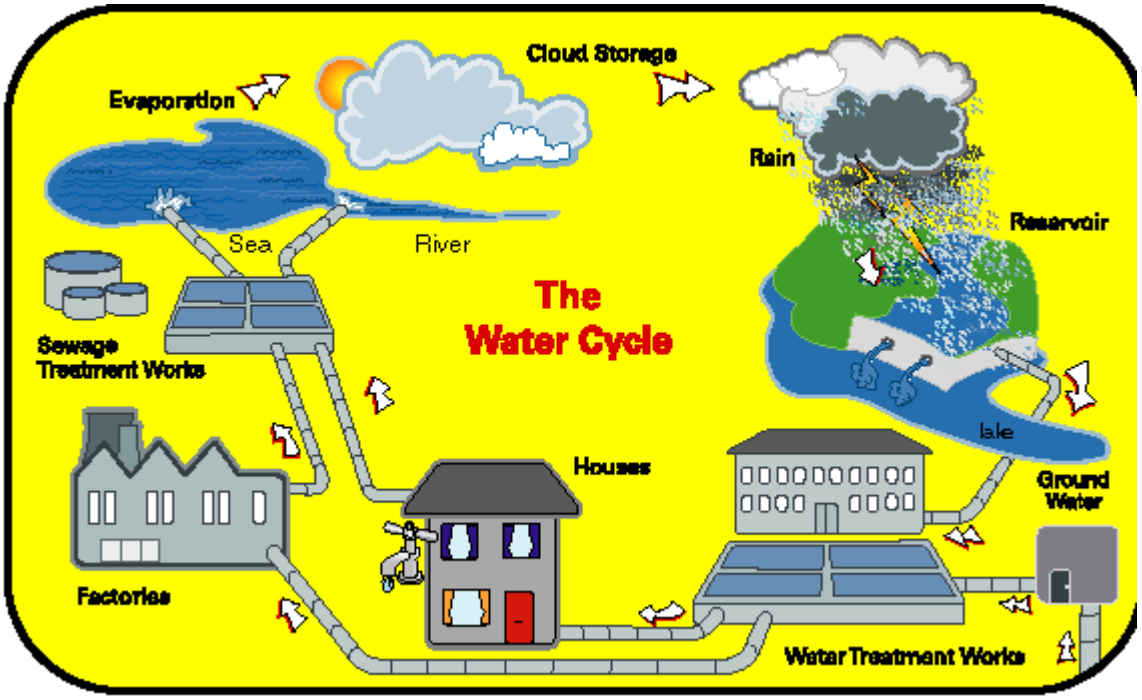
The map overleaf indicates the areas that supply consumers with ground waters and surface waters and to what percentage.

Water Sources in England & Wales



Why do source waters need treatment?

Water is not taken from sources that are highly polluted, and water for drinking is drawn only from good quality surface and ground water. But all water must still be treated before it is safe to drink. Contaminants can come from agriculture or industry. They may, for example, include treated sewage effluents, and traces of agriculture chemicals in areas where farming is practised. All sources are disinfected to kill germs, known scientifically as pathogens, which may have entered water sources from human or animal wastes.



Ground waters are usually of higher quality than surface sources. However, they can contain traces of agricultural chemicals and a few may contain toxic chemicals, which occur naturally in some aquifers.

Waters in large lakes or storage reservoirs undergo a natural purification stage - factors such as sunlight help eliminate pathogens naturally. These waters are usually retained for up to six months before being treated.

How is my tap water treated to make it safe to drink?

There are a wide variety of water treatment processes available. Those used are tailored to the quality of the water source that has to be treated. Ground waters usually require very little treatment. River water tends to require more comprehensive treatment to remove chemical pollutants. All sources require disinfection with chlorine to kill pathogens, including bacteria and viruses.

Treatment

Some of the most commonly used stages of treatment are described briefly here. Some water companies offer guided visits to their water treatment works where visitors can view the processes. For more information, contact your water company.

Clarification

Clarification is a complex process that removes silt, algae, colour, manganese and aluminium, and various other matter that may be present in the raw water. A chemical called a coagulant, which is usually an iron or aluminium salt, is added to the raw water and combines the material that has to be removed into larger particles. These are removed either by settling them out (sedimentation) or by using air to float them to the surface (flotation). Clarification also removes about 90 per cent of pathogens from

the raw water.

Filtration

Any particles remaining after clarification are removed at the filtration stage. Filtration is also used to remove iron and manganese from ground water sources. There are a number of types of filter, the most common being rapid gravity filters. The water passes through a bed of sand or other suitable media, where the particles become trapped. After a given period of time the flow through the filter is reversed in order to clean the sand. It is very important to remove as many particles as possible at the filtration stage for the final disinfection stage to be effective.

Membrane filtration is used in special applications, such as the removal of Cryptosporidium oocysts (see question two in the frequently asked questions section at the back of this leaflet for more information on *Cryptosporidium*).

Disinfection

In this country the most common method of disinfection is the use of chlorine (occasionally you may notice a slight smell of chlorine in your tap water). It is a method that has been used extensively for over 70 years. The disinfecting process is essential to eliminate any bacteria in the water. Water companies have to ensure that enough chlorine remains in the water after it leaves the treatment works to help keep the water safe on its journey to the tap.

Other disinfectants include ozone and ultra violet light, but these do not remain in the water during distribution, so in both cases a small amount of chlorine is added before water goes into distribution.

Chlorine can react with some natural organic matter present in the water to produce trace amounts of other chemicals, some of which are potentially toxic. These are known as disinfection by-products (DBPs). However, the risks associated with DBPs are small, and far outweighed by the benefits of disinfection. Without it waterborne diseases such as cholera, dysentery and typhoid could rapidly re-establish themselves. DWI has a leaflet available free of charge called Chlorine, Smell, Taste.

Disinfection is not very effective against parasites such as *Cryptosporidium* and *Giardia* (which can cause illnesses with severe diarrhoea lasting a number of weeks). If there is a risk of these being present they must be removed during the filtration stage of treatment.

Some waters require more specialised treatment, such as:

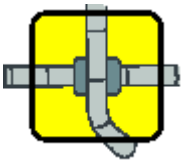
Ion exchange

This process is used to remove nitrate from ground water, and also in some cases to soften water. Ion exchange is very similar to the process used in domestic water softeners, where water is passed through a bed of special resin particles.

Activated carbon and ozone

Activated carbon, often in association with ozone, is used to remove organic substances. Some of these occur naturally and others are contaminants that occur because of man's activities, such as pesticides. The ozone breaks down the organics, which are then adsorbed on the surface of the carbon.

Distribution



When water leaves the treatment works it is delivered to consumers' homes through a network of distribution pipes made of cast iron, plastic or cement.

Treatment residues and corrosion products from cast iron pipes can settle in areas of low water flow within the distribution system. If these deposits are disturbed, consumers are likely to receive discoloured water, which may be unpalatable and displeasing. Water companies therefore need to manage their distribution systems by avoiding rapid changes in flow and by flushing to remove the deposits. This situation has improved in many areas over the last 10 years due to major refurbishment programmes. Companies are currently investing millions of pounds to reline or replace their cast iron distribution systems. DWI has a leaflet available free of charge called *Discoloured Water*, which offers further advice.

Water quality standards and testing

The water quality regulations set legal standards for water, which must be met by water companies in England and Wales. Most of these are based on a European Community directive, but some UK standards are more stringent. Many of the standards are based on World Health Organisation guidelines and include very wide safety margins. The regulations and standards are on the DWI web site at www.dwi.gov.uk.

The table at the end of this leaflet sets out the substances that water is tested for and the amounts allowed by law.

As the 'guardians of drinking water quality', the main role of the Drinking Water Inspectorate is to enforce the regulations and check that water companies in England and Wales supply water that is safe to drink and meets the standards set in the regulations. DWI has a leaflet available free of charge called What do we do? offering further advice.

Frequently asked questions

1.Q-"I don't like the taste of chlorine in my water. What can I do?"

A- Occasionally you may notice a slight smell or taste of chlorine. Place a covered jug of water in the fridge until it is cool. It will then be fine for drinking, but remember to use the water within 24 hours.

2.Q-"Does chlorine kill bacteria and bugs such as Cryptosporidium?"

A- Disinfection kills bacteria in water. But it is less effective in eliminating Cryptosporidium, which is a small organism found in man and many other animals. It can cause a disease called cryptosporidiosis, which is a diarrhoeal illness usually lasting about two weeks. Water that has not been suitably filtered can contain numbers of *Cryptosporidium* oocysts shown to cause illness. New regulations require water companies to continuously sample and analyse for *Cryptosporidium* daily. It is a criminal offence for a water company to breach the treatment standard. DWI will continue to check that the regulations are being met.

3.Q-"Why does the water sometimes look cloudy when it comes from the tap?"

A-Water can be cloudy as a result of chalk deposits or excess air. Cloudy water caused by excess air clears from the bottom up on standing freshly poured water in a glass, and is not something to worry about. Chalk deposits are not harmful but may be associated with other deposits and you should contact your water company.

4.Q-"Are there any nitrates or pesticides in tap water?"

A- Nitrate comes from fertilisers and oxidation of sewage effluents. Too much nitrate can be harmful to young babies (it may cause symptoms of blue baby syndrome). The standard for nitrate has been set to avoid this, and there has not been a case reported since 1972. Where necessary water companies are required to reduce nitrate levels in drinking water. Pesticides come from their use by farmers, gardeners, railways and highways authorities. The standard for individual pesticides is very stringent. Where necessary, water companies have installed additional treatment and, as a result, pesticides have been virtually eliminated from drinking water.

5.Q-"Is wastewater recycled to produce tap water?"

A- Wastewater is not treated and converted directly into drinking water. Water companies are required to treat wastewater to an acceptable standard before the effluent can be returned to our natural waters. The amount of dilution is always taken into account and this ensures that the raw water that is eventually drawn for drinking purposes is clean enough to be treated and disinfected for distribution. The answer to the next question further expands on this area.

6.Q-"Is it true that there may be drug residues in tap water?"

A- Concerns have been expressed about residues from pharmaceuticals in drinking water, and also endocrine disrupters. These are chemicals that are excreted by humans. In high concentrations they have been shown to induce female characteristics in male animals. In general, if one makes a worst case assumption that pharmaceuticals are excreted unchanged and recycled via tap water, the theoretical dose would be about 1 million times less than the pharmacologically active dose. The actual dose is much less than this because all sewage effluents are subject to intensive biological treatment before being discharged to watercourses. This treatment removes organic matter and greatly reduces the polluting potential of the effluent. Further biodegradation takes place in the rivers and reservoirs and treated sewage

effluent has a minimal impact on overall water quality. Sophisticated treatment processes, such as ozone or activated carbon, used in the production of drinking water, further reduce the concentrations of chemical residues to insignificant levels.

7.Q-"Should I use a water filter?"

A- Water filters are unnecessary. However, if you decide to use a filter, you **must** follow all the manufacturer's instructions carefully, as failure to do so result in high concentrations of bacteria as well as imparting taste and odour to the water.

8.Q-"The water supplied to my area is quite hard. Should I use a water softener?"

A- This is a matter of personal choice. A softener may lessen the problems experienced by people with skin irritation and will reduce scaling in hot water systems. If a softener is installed, you must make sure a supply of unsoftened water is available for drinking and cooking as softened water can have high levels of sodium. DWI has a leaflet available free of charge called *Water Hardness* that gives further advice.

9.Q-"Should I drink bottled water?"

A- This is a matter of consumer choice. Tap water is safe to drink and blind taste tests have shown that consumers can not distinguish chilled tap water from bottled water.

10.Q-"Should I drink water from the taps in my bathroom?"

A- You should drink water from the cold bathroom tap only if the water comes directly from the supply main. Otherwise, you should always use water from the cold water tap in the kitchen. The cold water taps in the bathroom may be supplied from a storage tank in the loft so the quality may not be as good as that from the kitchen tap, which comes directly from the mains. Do not drink water from hot water taps as it may contain high levels of copper.

11.Q-"I have just moved in to an old house with lead pipes. Should I have the pipes replaced?"

A- Houses built before 1970 may have lead pipes. You should always try and minimise exposure to lead. Babies and children are particularly at risk, as studies have shown that lead can have a small effect on their mental development. You can ask your water company to take samples and they will tell you the results. They will also provide advice if the standard for lead is exceeded. If you have lead pipes it is better not to drink water that has been standing overnight or for several hours in the pipes. Instead, draw off a washing-up bowl full of water from the kitchen tap (and use it to water the garden, for example), after which the water can be used. The best solution is to replace the pipes with copper or plastic ones. Once the pipes have been replaced, you can request the water company to replace any lead pipes leading to your property. DWI has a leaflet available free of charge called *Lead in Drinking Water – Have You Got Lead Pipes?* that gives more

advice.

12.Q-"Why is it necessary to use lead-free solder when installing copper drinking water pipes?"

A- The Water Supply (Water Fittings) Regulations prohibit the use of lead solder as it may cause lead levels to exceed the drinking water standard for lead. This could be harmful to health, particularly to babies and children. Only lead-free solder should be used. It is essential that minimum quantities of flux and solder are used and, after soldering, that all traces of flux are flushed away in order to prevent corrosion, which could contaminate the water.

DWI has a leaflet available free of charge called *Using Lead-free Solder for Water Supply Fittings* that gives more advice.

13.Q-"If I am experiencing problems with the quality of my tap water, who should I contact?"

A- In the first instance you should contact your water company and report the water quality problem. If you find that the water company does not put the problem right, contact DWI and we will investigate the matter further. You may also contact the OFWAT Customer Service Committee in your area, which handles all consumer complaints.

14.Q-"Do the staff at DWI drink tap water?"

A- Yes, we do. The office has a cooling unit which makes the tap water very pleasant to drink. Even the Chief Inspector will testify to this! Tap water is healthy, contains no cholesterol, fat or calories and should be consumed regularly to keep the body from dehydrating. Medical experts have recommended that adults consume two litres (eight glasses) of water each day and children approximately half that amount.

Substance	Description	Standard
Microbiological parameters		**Amount Allowed**
Faecal coliforms, faecal streptococci, *Clostridium perfringens*	Faecal coliforms, faecal streptococci and *Clostridium perfringens* are present in the gut of all warm-blooded animals. Their presence in water supplies indicates a need to take immediate action to remove the source of faecal pollution. Each is sampled and tested for individually. These organisms are controlled through the disinfection of water.	0 per 100 ml
Total coliforms	The coliform group of organisms is widely distributed in the environment, for example through human and animal activity and through vegetable matter. Their presence in water supplies indicates	0 per 100 ml

	a need to investigate the source of contamination. Coliform numbers are controlled through the disinfection of water.	
Chemical parameters		**Amount Allowed**
Alkalinity	The concentration of this parameter is an indication of the natural hardness and pH of the water.	No standard
Aluminium	Occurs naturally in some source waters. Aluminium sulphate is used as a water treatment chemical to remove cloudiness. It is removed during the water treatment processes (coagulation and filtration).	200 µg/l
Ammonium	Ammonium salts are naturally present in trace amounts in most water sources. They are decomposed during disinfection.	0.5 mg/l
Antimony	Antimony is toxic and is not present in water sources. Trace concentrations in drinking water, which are not of any significance to health, can be derived from brass fittings and from solders.	10 µg/l
Arsenic	Naturally present at trace levels in a very few groundwater sources. Arsenic is toxic and when present it is removed by specialist water treatment processes.	50 µg/l
Barium	Occurs naturally in trace concentrations in some water sources. The concentrations present in water do not present any risk to health.	1000 µg/l
Boron	Boron in water sources comes from the residues of detergent formulations that are present in treated sewage effluents. The concentrations present in water do not present any risk to health.	2000 µg/l
Cadmium	Cadmium is toxic and present at trace levels in a very few groundwater sources. When present it is removed by specialist water treatment processes.	5 µg/l
Calcium	Occurs naturally in all water sources and along with magnesium is responsible for the hardness of water, which causes scale in kettles and hot water systems. The concentrations present in water do not present any risk to health.	250 mg/l

Chloride	In association with sodium it occurs naturally as a very dilute salt in all water sources and is not removed during water treatment. The concentrations present in water do not present any risk to health.	400 mg/l
Chlorine	Chlorine gas is used as a disinfectant in water treatment. It destroys bacteria derived from animal wastes and sewage effluents.	No standard
Chromium	Not present in water sources and is not found in drinking water.	50 µg/l
Colour	Colour occurs naturally in water from upland sources. Colour is removed during the water treatment processes (coagulation and filtration).	20 mg/lPt/Co scale
Conductivity	Electrical conductivity is a measure of the amount of natural dissolved inorganic substances in source water. It is used to assist treatment control.	1500 µS/cm
Copper	Traces of copper which are not significant to health occur naturally in many water sources and significant concentrations may occur at consumers' taps as a consequence of copper pipes. The concentrations present in water do not present any risk to health.	3000 µg/l
Cyanide	Cyanide is toxic and is not present in water sources. It is not found in drinking water.	50 µg/l
Fluoride	Traces of fluoride occur naturally in many water sources, particularly ground water. It is not removed by conventional water treatment and some water companies artificially fluoridate water supplies as a protection against tooth decay. See the DWI web site for more information on fluoridation of drinking water.	1500 µg/l
Iron	Present naturally in many water sources. Iron compounds are used as water treatment to remove cloudiness. Iron is removed during water treatment. Iron in water supplies may also be derived from corrosion of iron mains. The concentrations present in water do not present any risk to health.	200 µg/l
Lead	Not normally present in water sources but	50 µg/l

	may be present at consumers' taps if lead pipes are present. If the water supply tends to dissolve lead, water companies must protect the health of consumers and treat the water to reduce exposure.	
Magnesium	Occurs naturally in all water sources and along with calcium is responsible for the hardness of water, which causes scale in kettles and hot water systems. The concentrations present in water do not present any risk to health.	50 mg/l
Manganese	Present naturally in many water sources and is removed during water treatment.	50 µg/l
Mercury	Mercury is toxic and is not present in water sources or drinking water.	1 µg/l
Nickel	Not found in water sources; traces in drinking water, which do not present a risk to health, are derived from protective coatings on taps and fittings.	50 µg/l
Nitrate	Present naturally in all source waters, although higher concentrations can be caused by use of fertilisers. Where necessary, nitrate levels are reduced during water treatment (ion exchange or blending with low nitrate water). See the DWI web site for information on health implications and control measures.	50 mg/l
Nitrite	Traces of nitrite are produced when chlorine and ammonia are used in the disinfection process. Levels are minimised through careful operation of the disinfection process. See the DWI web site for more information (under 'nitrite').	0.1 mg/l
Oxidisability	The oxidisability of the water provides a measure of its organic content. This is an alternative measure of TOC.	5 mg/l
PAH	Polycyclic aromatic hydrocarbons are present in coal tar linings, which were used to protect water mains before 1970. Traces of PAH, at concentrations that are not of significance to health, are present in tap water if the original coal tar lining is still present.	0.2 µg/l
Benzo3,4 pyrene (a PAH)		10 ng/l
Pesticides	Many water sources contain traces of toxic pesticide residues as a result of agricultural and non-agricultural uses of	0.1 µg/l

	pesticides on crops, and weed control. Where necessary, water companies have installed special treatment processes to protect public health by removing pesticides (activated carbon and ozone processes). See the DWI web site for information on pesticide removal.	
PH	A low pH value may result in pipe corrosion. An alkali which is not harmful to health may be added before supply so that corrosion is minimised.	5.5-9.5
Phosphorus	Traces of phosphorus salts occur naturally in many water sources and high concentrations are associated with treated sewage effluents and agricultural fertilisers. Phosphates are also used in water treatment as a health protection measure to reduce lead content that may come from consumers' pipes. The concentrations present in water do not present any risk to health.	2200 µg/l
Potassium	Occurs naturally in all water sources and is not removed during water treatment. The concentrations present in water do not present any risk to health.	12 mg/l
Qualitative odour and taste	Odour and taste occur naturally, particularly in surface water sources during the summer. The organics are removed during the water treatment process (activated carbon or ozone). They are sampled and tested for individually.	No standard
Quantitative odour and taste	A measure of odour and taste in water. They are sampled and tested for individually and are removed during the treatment process described above.	Dilution No of 3 at 25°C
Selenium	Selenium is toxic and is not present in water sources and is not found in drinking water.	10 µg/l
Silver	Not present in source waters and is not found in drinking water unless silver is being used as a treatment chemical; this is not the case in England and Wales.	10 µg/l
Sodium	In association with chloride, sodium occurs naturally as a very dilute salt in all water sources and is not removed during water treatment. The concentrations present in water do not present any risk to	150 mg/l

	health.	
Sulphate	Occurs naturally in all source waters and is not removed during water treatment. The concentrations present in unsoftened water do not present any risk to health.	250 mg/l
Surfactants	Surfactants in water sources come from the residues of detergent formulations that are present in treated sewage effluents. They are removed during treatment.	200 µg/l
Temperature	The temperature of surface waters varies according to the season. Groundwater has a much smaller variation in temperature range.	25°C
Tetrachloroethene	These solvents can be present at low concentrations in groundwater under industrial areas. Where necessary, specialist treatment is used to protect public health by removing solvents from drinking water.	10 µg/l
Tetrachloromethane		3 µg/l
Trichlorethene		30 µg/l
Trihalomethanes (THMs)	THMs are formed during the disinfection process by reaction between chlorine and mainly naturally-occurring organic substances. Treatment processes are controlled to minimise their production. See the DWI web site for information on the control of THMs.	100 µg/l
Turbidity	All source waters are naturally cloudy occasionally. Turbidity is a quantitative measure of cloudiness and levels are controlled by the treatment processes.	4 Formazin Turbidity Units
Total dried solids	This is a measure of the naturally-occurring minerals in water.	1500 mg/l
Total hardness	This represents the concentration of both naturally-occurring calcium and magnesium in the source water. Hard water can cause scale formation in kettles and hot water systems. The concentrations present in water do not present any risk to health.	No standard
Total organic carbon (TOC)	TOC represents the total amount of organic matter present in the water. The concentrations present in water do not present any risk to health.	No significant increase
Zinc	Significant concentrations of zinc in water are only found in premises served by	5000 µg/l

	galvanised iron service pipes. Traces of zinc which are not of significance to health may be derived from solders.	

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