# Lead in Drinking Water

## Research Paper 97/65

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The European Union is currently revising its drinking water directive, and is proposing a substantial reduction in permitted levels of lead in drinking water over a fifteen year period. This paper examines the implications for the UK of the revised standard in the light of current levels of lead in drinking water in the UK and the prevalence of lead pipework for water supply. It discusses the current scientific evidence of the health risks from lead, and action being taken to reduce levels of lead in drinking water and remove pipes. The paper examines the ways in which compliance with the proposed new standard for lead can be achieved and the likely costs and benefits.

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# Summary

Lead is a metal which is toxic to humans, and of which there is no safe level. Scientific studies have concluded that exposure to even low levels of lead can cause a small but significant reduction in the IQ of children.

Lead has been widely used in pipes to distribute drinking water since Roman times. Lead levels in drinking water when it is put into the distribution system are generally very low. However, in properties whose drinking water is still supplied through lead pipework, it can dissolve into the water at concentrations above current legal standards for drinking water quality as well as health guidelines. Although new lead pipes are no longer installed, some 8.9 million homes in England and Wales are estimated to have lead water supply pipes.

The European Union is currently in the process of revising its drinking water directive, originally adopted in 1980. One of the most significant changes in the new directive will be a substantial reduction in the permitted concentration of lead in drinking water, to only 20% of its current level. Member States will have to meet the new standard within 15 years. This may require the replacement of lead pipes throughout the UK, the costs of which have been estimated at between £7-10 billion.

This paper examines current scientific evidence of the health risks from lead and the relative contribution of drinking water to these. It reviews current levels of lead in drinking water and prevalence of lead pipework in the UK, and identifies the actions which are currently being undertaken in various sectors to reduce levels of lead in drinking water and remove lead pipes. It also addresses the steps which consumers can to take to inform themselves of these issues. The paper further examines the ways in which compliance with the proposed new standard for lead can be achieved and the likely costs and benefits to be derived from meeting the new standard.

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# I Introduction

## A. What is lead?

Lead is a soft, silvery grey metal, one of a group of chemicals known as heavy metals. Although lead is highly resistant to corrosion, it dissolves in nitric and sulphuric acids. Lead exists in different forms, some of which are also soluble in water[1]. It is used in the production of lead-acid car batteries, solder and alloys, and has other uses such as in ammunition. Two forms of lead, tetraethyl and tetramethyl lead are still widely used in leaded petrol, although this has largely been phased out in North America and Western Europe[2]. Similarly, lead has been used as a constituent of paint, but this, too, has been significantly reduced. Until the mid to late 1960s, it was standard practice for lead to be used in pipework connecting water mains with properties (known as service pipes) as well as within the properties themselves. Lead has also been used for water tanks, plumbing fittings, and as solder in water distribution systems[3].

## B. Sources of exposure

Human exposure to lead occurs via the air, dust and soil, and the diet. Because of the widespread commercial use of lead, its origins in the environment are generally man-made rather than natural ones[4]. Exposure is assessed by taking a blood sample from the individual and measuring the amount of lead present. Blood lead concentrations are usually expressed in microgrammes of lead present in one decilitre of blood (µg/dl)[5].

Whilst there are a number of sources of exposure to lead, most people receive their highest proportion of daily lead intake through their diet, although children are exposed to additional lead from dust and soil[6,7]. Lead can contaminate food through crop uptake of lead in soil and contaminated water, and by deposition from lead in the air. Food can also become contaminated during its production and storage. Estimates of the actual amount of lead consumed as part of the diet vary widely. Nevertheless, exposure to lead through food is still

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1 World Health Organisation /United Nations Environment Programme/International Labour Organisation *Environmental Health Criteria 165 Inorganic Lead* WHO Geneva 1995.

2 World Health Organisation *Guidelines for Drinking Water Quality Second Edition: Volume 2 Health Criteria and other Supporting Information* WHO Geneva 1996.

3 ibid.

4 World Health Organisation Regional Office for Europe *Toxicology: Lead and Health* WHO Denmark 1995.

5 1 microgramme = 1 millionth of a gramme, 1 decilitre = 100 ml.

6 Reference 1.

7 ibid.

generally low and studies in the UK and United States have shown that there has been a substantial reduction in levels of lead ingested as part of the diet since the late 1970s[8,9].

Recommended intakes of lead through food and drink were provisionally set in 1986 by the Joint Expert Committee on Food Additives (JECFA), a joint body of the WHO and Food and Agriculture Organisation of the United Nations. This recommended maximum level of dietary lead is known as the Provisional Tolerable Weekly Intake (PTWI). It was re-confirmed by JECFA in 1993 and is set at 25 µg of lead per kilogramme of body weight. It includes the contribution from drinking water and applies to all age groups. A survey of lead in food and drink in the UK, carried out in 1991 by the Ministry of Agriculture Fisheries and Food (MAFF), concluded that the estimated intake of lead from the foods it surveyed would be well within the PTWI. This study also recorded reductions in levels of lead in food, but in contrast to other studies, it attributed the reduction to the use of more sensitive equipment rather than any genuine decrease in food lead levels[10].

The relative role of drinking water in contributing to total dietary lead intake is fairly small for children and adults, but is significant for bottle-fed infants. On average lead in food (excluding water), dust and dirt combined account for approximately 80% of daily intake[11]. The WHO acknowledged as far back as 1984[12] that very little of the considerable amount of study that there has been into lead has directly addressed the issue of the health effects of lead consumed through drinking water. This largely remains the case. However, in the Explanatory Memorandum[13] issued by the European Commission to accompany its proposal for a revision of the drinking water directive[14], the issue of the contribution of lead to the PTWI was raised. The Memorandum states that any concentration of lead in drinking water greater than the proposed 10 µg/1 standard would mean that an infant would exceed its PTWI:

> This means that the quantity of lead that an infant would receive under normal nutritional habits using water with a lead content of 10 µg/1 is just in the range of the provisional tolerable weekly intake. The value of 10 µg/1 therefore includes little or no uncertainty factor.

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8 Bolger P.M., Carrington C.D., Capar S.G., & Adams M.A (1991) Reductions in Dietary Lead Exposure in the United States *Chem. Speciation Bioavailab.*, **3** (314):31.

9 OECD (1993) *Risk Reduction Monograph No.1: Lead Background and National Experience with Reducing Risk*. Paris OECD 277 pp (Report No. OCDE/GD(93)67).

10 Ministry of Agriculture Fisheries and Food *Food Surveillance Information Sheet Number 34 MAFF UK - 1991 Total Diet Study* July 1994.

11 Reference 2.

12 World Health Organisation *Guidelines for Drinking-Water Quality Vol.1 Recommendations* WHO Geneva 1984.

13 EC draft 7208/95, published 17 May 1995.

14 80/778/EEC *OJ L229* 30 August 1980.

## C. Recent trends in blood lead levels

Blood lead levels in countries such as the UK, Germany, Belgium, and Sweden have decreased significantly since the late 1970s[15] and in the United States blood lead levels in the 1990s have fallen to around one third of their 1970s levels[16]. Blood lead levels recorded in a survey of 6,868 subjects, examined as part of the health survey for England in 1995, were found to have fallen by a factor of 2.6-3.0 in adults and a factor of 3.6-5.0 in children[17] since 1984.

Much of the decline in levels of lead in blood in developed countries has been attributed to the reductions which have been achieved in levels of airborne lead from motor vehicles. In the UK, for example, the maximum permissible lead content of petrol was more than halved in January 1986 and around 70% of petrol now sold in Britain is unleaded. Annual average levels of airborne lead in urban areas of the UK have decreased significantly[18]. Decreases in blood lead have also been attributed to the removal of lead solder from food cans[19].

Whilst any decline in exposure to lead must be welcome, it is important to consider that, in the context of decreasing levels of lead from airborne sources and food, the relative contribution of drinking water to total lead exposure increases, making drinking water more important as a source of exposure to lead.

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15 Reference 1.

16 Hayes, E.B. The Hazards of Lead to Children *Environmental Medicine* 383-389 Mosby St.Louis 1995.

17 Blood Lead Concentrations in United Kingdom Have Fallen Since 1984 Letter to *BMJ* **313** 883-884

18 Department of the Environment/Scottish Office *The United Kingdom National Air Quality Strategy* Cm 3587 March 1997.

19 References 16 & 17.

# II Health effects of lead

## A. Metabolism

Around 10-15% of dietary lead is absorbed by adults and up to 30% by children[20], although diets which are deficient in calcium, phosphate, selenium or zinc may increase absorption. Lead consumed in drinking water is easily absorbed because it is already in a soluble form. It is transported via the red blood cells to the soft tissues of the body such as the liver, lungs, spleen, kidneys and bone marrow, where it remains for a relatively short time[21]. Its half-life (the amount of time it takes for levels to decrease by 50%) in the soft tissues is around 5-7 weeks. Thereafter, the lead is absorbed by the skeleton where it remains for long periods, with a half-life of 17-27 years[22], as it is slowly released back into the blood. In children, however, the half-life of lead may be considerably longer[23].

In pregnant women lead can be transferred across the placenta from around 12 weeks of gestation onwards[24]. Studies reviewed by the WHO[25] have shown that blood lead concentrations in the umbilical cord are in the order of 80-100% of maternal blood lead levels, and the same is true of blood lead in the foetus.

The 85-90% of dietary lead in which is not absorbed in adults is excreted in the faeces, and lead which is absorbed but then subsequently not retained by the body is excreted via the kidneys. The studies reviewed by the WHO show that, in infants and young children, intakes of greater than 5 µg of lead per kilogram of body weight result in net retention of lead, whilst with intakes of less than this level, excretion is greater than retention[26]. As a very stable element, lead is not generally metabolised (chemically or biologically changed) by the body and because of this stability, lead which is retained by the body slowly builds up over long periods of time, hence the long half-life.

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20 Linz, D.H & Garling, D.J. Toxicology of Selected Neurotoxic Agents *Environmental Medicine* 129-138 Mosby St.Louis 1995.

21 Moore M.R. Haematological Effects of Lead *Science of the Total Environment* 1988 **71** 419-431.

22 Rabinowitz M.B. et al Kinetic Analysis of Lead Metabolism in Healthy Humans *Journal of Clinical Investigations* 1976 **58** 260-270.

23 Reference 2.

24 Barltrop D. Transfer of Lead to the Human Foetus. In: Barltrop D, Burland WL, eds. *Mineral Metabolism in Paediatrics* Oxford Blackwell 1969: 135-151.

25 Reference 2.

26 ibid.

## B. Lead poisoning

A wide range of the health effects of lead has been studied, based upon both chronic and acute exposure. The most severe effect of lead on health is lead poisoning, and its symptoms and effects are well-documented. Blood lead levels above 80 µg/dl are regarded as dangerous[27], and levels of 100-120 µg/dl in adults and 80-100 µg/dl in children can cause lead poisoning. The symptoms of lead poisoning vary according to its severity, from restlessness, irritability and tiredness to muscle tremor, abdominal cramps, loss of memory, kidney damage, and encephalopathy, a severe brain disorder.

Lead poisoning can be treated by removing the source of exposure and giving the patient chemicals known as chelating agents, which render the lead compound harmless. It can then be excreted. Drugs can also be used to help reduce blood lead levels, after which the patient may be put on a low calcium diet to help mobilize the lead stored in the bones, so that it can also be excreted from the body[28].

## C. Psychological and behavioural effects

Whilst the severe health effects of lead (in terms of lead poisoning) are well known, the more subtle effects of exposure to lower concentrations of the chemical have also been subject to considerable scientific scrutiny. There has been widespread concern that exposure of children to low levels of lead could cause mental retardation and behavioural problems by damaging the developing brain. The most substantial evidence involving relatively low blood lead levels (less than 25 µg/dl) concerns decreases in intelligence quotient (IQ).

One of the most recent and comprehensive reviews of scientific literature on the effects of environmental lead on childhood intelligence was carried out by the WHO's International Programme on Chemical Safety (IPCS), the body whose evidence largely informs the WHO in setting its drinking water quality guidelines (see Section III, B). In an evaluation of the scientific studies into the effect of low level exposure of lead on children's IQ, IPCS concluded that, in children with blood lead concentrations in the range of 15-25 µg/dl, every 10 µg/dl increase in blood lead levels would result in a loss of between 1 and 3 IQ points[29]. The IPCS concluded, however, that there was no *definitive* evidence of a causal relationship between lead exposure and IQ deficit in human studies, although the animal studies which it also reviewed did provide support for a causal relationship between lead and nervous system effects.

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27 Black's Medical Dictionary 38th Edition A&C Black London 1995.

28 ibid.

29 Reference 4.

Many of the studies examined by the IPCS were reviewed in a 1994 paper by Pocock *et al*[30], which looked at the evidence from 26 epidemiological studies into the effects of lead on childhood intelligence. This review broadly concurred with the WHO. It found that the studies showed that blood lead in children aged around 2 years had a "small but significant inverse association with IQ" *i.e*. increased blood lead was associated with decreased IQ. The review further concluded:

> The 14 cross sectional studies[31] of blood lead with 3499 children showed a significant inverse association overall, but showed more variation in their results and their ability to allow for confounders. The seven cross sectional studies of tooth lead with 2095 children were more consistent in finding an inverse association, although the estimated magnitude was somewhat smaller. Overall synthesis of this evidence...indicates that a typical doubling of body lead burden (from 10 to 20 µg/dl...) blood lead or from 5 to 10 µg/g tooth lead is associated with a mean deficit in full scale IQ of around 1-2 IQ points.

## D. Carcinogenicity

The implication of lead as a cause of cancer in humans is not proven. A small number of epidemiological studies have been carried out, but these have not been conclusive. Two studies reported evidence of an association between lead and renal (kidney) cancer, but IPCS considered that confounding effects had not been addressed. In animal studies, however, renal tumours have been induced in rats, mice and hamsters, but only in extremely high doses of upwards of 500 milligrams of lead per kg of body weight.

The current understanding of the carcinogenicity of lead is probably best summarised by the WHO[32]:

> The evidence for the carcinogenicity of lead is inconclusive because of the limited number of studies, the small cohort sizes, and the failure to take adequate account of potential confounding variables. However, an association has been demonstrated experimentally between the ingestion of lead salts and renal tumours. Lead and inorganic lead compounds have therefore been placed in Group 2B of the IARC classification, namely possible human carcinogen (evidence inadequate in humans, sufficient in animals).

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30 Pocock, S.J., Smith, M. & Baghurst, P. Environmental Lead and Children's Intelligence: A Systematic Review of the Epidemiological Evidence *BMJ* **309** 1189-1197.

31 Cross-sectional studies involve information about a population at a defined point or short period in time, with particular reference to the characteristics of the individuals which are part of that population and their exposure to factors considered likely to predispose them to disease. Cohort studies, referred to subsequently in this Section, are longitudinal and involve following the population for a defined period of time or until the occurrence of a specific event, such as the development of illness or death, in order to observe patterns of disease and/or cause of death. Prospective studies are forward-looking longitudinal studies in relation to morbidity.

32 Reference 2.

## E. Other health effects

One of the other main areas of focus for study has been on the health effects of lead on pregnant women and developing foetuses, especially (in the case of the latter) since lead can be transferred across the umbilical cord, and because the ratio of maternal to cord blood lead levels are similar. In reviewing scientific evidence on lead to set its 1984 drinking water guidelines, the WHO noted that "Pregnant women and fetuses also appear to be more sensitive to lead because of increased maternal food intake and changes in hormonal status". This point was also raised by the Scottish Office in its 1994 review of drinking water quality in Scotland[33], which contained an annex on lead. The report commented on the fact that lead stored in the bones can be demineralised during pregnancy (and in post-menopausal women) which "has implications for the developing foetus".

However, the WHO did not raise this issue in the published health criteria and supporting information used to review the drinking water guidelines in 1993 and the effects of lead on unborn foetuses appear generally to have been discounted in recent years by reviews of scientific literature. Furthermore, the Pocock study on the effects of lead on children's intelligence concluded that:

> The five prospective studies with over 1100 children showed no association of cord blood lead or antenatal maternal blood lead with subsequent IQ.

An epidemiological study of the north west of England, recently reported by the environmental journal *ENDS*[34], does, however, provide support for this theory. It is reported that the study found:

> that high lead levels may also cause neural deformities in developing embryos. The evidence is strongest for anencephaly - a fatal disorder in which the brain fails to develop - but there are also links with spina bifida, in which abnormal spinal development causes permanent paralysis.

Lead has been attributed to several other disorders, namely high blood pressure, renal tubular damage, and reproductive effects. Tubular effects are usually reversible and kidney failure requires chronic exposure to high lead levels. Reproductive effects and those on blood pressure are not well documented.

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33 Scottish Office *Drinking Water Quality in Scotland 1994* Scottish Office Agriculture, Environment and Fisheries Department December 1995.

34 Bound, J.P. *et al*, 1997, *Archives of Disease in Childhood* **76**, pp 107-112 in *ENDS Report* 266 March 1997.

# III The lead problem in the UK

## A. The legal framework for drinking water quality

Standards for drinking water quality in England and Wales are set out in the *Water Supply (Water Quality) Regulations 1989*[35] (as amended). In Scotland, and Northern Ireland there are similar Regulations, which set the same drinking water standards as those in England and Wales.

The quality of drinking water is referred to in the Regulations in terms of the concept of its "wholesomeness". In order to be wholesome it must meet the numerical quality standards prescribed for 55 separate chemical and microbiological parameters, plus two further descriptive standards for taste and odour, and additionally must not pose a risk to public health. The Regulations incorporate the European Union (EU) Directive on drinking water quality[36].

## B. Standards for lead in drinking water

The current standard for lead in drinking water in the UK is 50 µg in any litre of water sampled. Each sample tested must comply with this level. Water companies are required by law to carry out regular tests on the water they supply, in order to ensure that it is wholesome and meets the standards prescribed by the Regulations. The Regulations also set out how sampling must be carried out for different parameters. For comparison with the 50 µg/l lead standard, drinking water must be sampled on a random basis at the customers' tap. Water companies are permitted to use lists of properties such as billing lists or electoral registers to randomly choose properties from which to sample. The sample taken must consist of the first litre of water which issues from the customer's tap[37]. This is known as a random daytime sample. The drinking water Directive also prescribes a 50 µg/l maximum admissible concentration (MAC), *i.e.* a maximum of 50 µg lead in any litre of water, but the Directive specifies that the tap should be flushed before the sample is taken, rather than being the first litre of water from the tap.

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35 SI 1989/1147.

36 Reference 14.

37 Department of the Environment/Welsh Office *Guidance on Safeguarding the Quality of Public Water Supplies* HMSO London 1989.

As well as mandatory drinking water standards, there are the WHO's drinking water guidelines, previously referred to, which have no statutory basis. These differ significantly from MACs because they have been derived to indicate levels at which, generally, a lifetime's exposure (or some shorter period) to the parameter in question would not represent any significant risk to health. It is not imperative, therefore, that the guideline is adhered to in every single sample of water. In 1993 the WHO reviewed its guidelines on drinking water quality and concluded that the 50 µg/l guideline which it recommended for lead in 1984 should be reduced to 10 µg/l. This was mainly based upon the fact that the JECFA had established a much lower PTWI for lead (see Section I) than that upon which the original guideline had been set. The new WHO guideline is set to protect infants, as the most sensitive group of the population. It assumes a 50% allocation of the 25 µg/kg body weight PTWI to drinking water for a 5 kg bottle-fed infant, consuming 0.75 litres of drinking water per day.

## C. The extent of lead in UK drinking water

Levels of lead in raw (untreated) surface water sources used for drinking water, such as rivers and streams, are normally well below the new WHO guideline value of 10 µg/l, and after normal water treatment processes, lead concentrations are generally in the order of 2 µg/l[38]. In theory, therefore, no-one should be exposed to lead from drinking water at levels in excess of the WHO guideline. However, because some forms of lead are soluble in water, and because there are still lead pipes in homes and connecting homes to water mains, lead can contaminate the water supply. This usually happens because the lead pipe becomes corroded and forms a coating of lead carbonate. Certain qualities of the water, notably acidity, can dissolve the lead carbonate into it. This ability of water to dissolve lead is known as plumbosolvency.

In addition to lead compounds dissolving into the water, deposits containing lead can build up in pipes and may occasionally be dislodged. People most likely to have significant concentrations of lead in their drinking water are therefore those living in older houses (which are more likely to have some lead plumbing) in areas with acidic soft water, although some alkaline hard water is also plumbosolvent. Acidic soft water is particularly prevalent in parts of Scotland, Wales and the north and Midlands of England.

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38 Water Research Centre *The Financial and Economic Implications of a Change of the MAC for Lea*d WRc Swindon 1995.

As well as direct corrosion, the effects of other metals such as copper can cause galvanic corrosion of lead pipes and solders containing lead, releasing both soluble and insoluble lead products into the water[39]. This point was raised by the Water Research Centre (WRc) in a 1995 report on the financial and economic implications of lowering the current 50 µg/l drinking water lead standard, prepared for the European Commission[40]. The WRc highlighted the possibility that combinations of lead and copper pipework may actually lead to higher concentrations of lead in drinking water than lead pipes alone.

## 1. Prevalence of lead pipework

An assessment of the current prevalence of lead pipework and associated fittings in UK drinking water systems was also given in the WRc's report:

> In England and Wales lead lined tanks or reservoirs have not been used in distribution. New lead pipes have not been installed since 1972. However, some companies ceased to use lead pipes as early as the 1940s, but more commonly lead has not been used since the 1960s.
>
> The majority of companies ceased to use lead as a mains jointing compound at a similar time. However, some still use lead to seal mains repairs. The risk associated with this has not been quantifiable, but it is thought to be negligible.
>
> In England and Wales lead solders have not been used since the late 1980s, and brass fittings are not commonly used now. However, the majority of the housing will still have lead solders and brass fittings. However, it is likely that the real effect these solders and fittings have on regulatory compliance will not be quantifiable until more of the lead has been replaced.
>
> In Northern Ireland and Scotland lead tanks have been used for water storage in domestic properties. No new tanks have been installed since the 1970s, the number of existing tanks is not known, but is thought to be negligible. Also lead solders are still permitted in Scotland but their use is discouraged.

As part of the same study, the WRc also estimated that there were almost 8.7 million lead communication pipes (connecting the water main to the stop valve) in use in England and Wales and almost 8.9 million lead supply pipes, which form the remainder of the pipework to the tap. In effect, therefore, roughly 8.9 million homes (34%) in England and Wales are estimated to have at least some lead pipework as part of their drinking water supply. No figures were provided in the WRc report on the prevalence of lead pipes in homes in Scotland and Northern Ireland. The Scottish Office estimates, however, that 589,000 homes in Scotland contain lead pipes[41].

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39 Britton, A. & Richards, W.N. (1981) Factors Influencing Plumbosolvency in Scotland *Journal Institution of Water Engineers and Scientists* **35**(5), 349-364.

40 Reference 38.

41 Reference 33.

## 2. Current levels of lead in drinking water

In 1995, the most recent year for which published data exist, around 33,000 statutory tests were carried out for lead in drinking water by water companies in England and Wales, and according to figures from the drinking water inspectorate (DWI)[42], almost 3.4% of samples exceeded the current standard of 50 µg/l. These failures occurred in almost one fifth of the zones into which water supply is divided[43]. Although the number of affected supply zones has been reduced from over a quarter of all zones in 1991, the percentage of lead samples which exceeded the standard is almost seven times higher than the overall failure rate for all parameters tested by the water companies in England and Wales, where only 0.5% of tests fail to comply. Data from a recent written answer[44] show that non-compliance with the lead standard in England and Wales has been highest in the Midlands, North-West and North-East England. Between 1991 and 1995, 5.0%, 4.2% and 3.5% respectively of samples taken in these regions had lead levels in excess of 50 µg/l.

Data published by the Scottish Office[45] for the last full calendar year that the Regional Councils were responsible for water services (prior to the establishment of the three new Scottish water authorities) show that 6,222 samples of drinking water were taken for lead analysis in 1995, of which 1.13% exceeded the 50 µg/l standard. In total, 9.6% of supply zones were affected. However, there is considerable variation in the results, with a number of councils recording no exceedances of the lead standard.

The most recent published data on levels of lead in drinking water in Northern Ireland are provided by the annual report of the Water Service, an agency of the Department of the Environment for Northern Ireland[46]. These data cover the last quarter of 1994 and all of 1995. During this period, 889 samples were analysed for lead, of which 3.15% exceeded the 50 µg/l standard. In total, 16.4% of water supply zones were affected.

The WHO's health criteria and information[47] used to support its recommendation for the reduction in the drinking water guideline for lead provides commentary on levels of lead in UK drinking water in the past two decades. It notes that:

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42 Drinking Water Inspectorate *Drinking Water 1995* Department of the Environment/Welsh Office, HMSO London 1996.

43 Water supply zones are the basic units of water supply. They generally serve populations of up to around 50,000 people and are used to establish sampling frequencies, compliance with standards and for providing information to customers about the quality of their own water.

44 HC Deb 14 October 1996 c817-818W.

45 *Drinking Water Quality in Scotland 1995* Scottish Office Agriculture, Environment and Fisheries Department August 1996.

46 Water Service *Drinking Water Quality Report for Northern Ireland October 1994 - December 1995* Department of the Environment for Northern Ireland 1996.

47 Reference 2.

> In the United Kingdom in 1975-76, there was virtually no lead in the drinking water in two-thirds of households, but in 10% of homes in England and 33% in Scotland levels were above 50 µg/l...In Glasgow (Scotland), where the water was known to be plumbosolvent, the lead concentration in about 40% of the samples exceeded 100 µg/l...

Long-term trends in levels of lead in drinking water, however, show substantial decreases in some parts of the United Kingdom and very little change in others. A 1975 UK survey of lead in drinking water, for example, found concentrations in excess of 50 µg/l in 5.2% of samples in England and 13.4% in Scotland[48]. Compared with 1995 figures of 3.4% and 1.13% respectively for tests carried out in England and Wales and Scotland, it is clear that levels of lead in drinking water have been considerably reduced in Scotland, whilst the improvement in England and Wales has not been so marked. The statutory sampling programmes reported by the inspectorates show that more random samples in England and Wales are now found with over 50 µg/l than is the case in Scotland.

This may perhaps be attributable to the fact that measures were taken earlier in Scotland, where, on the basis of sampling, there appeared to be a far greater problem with lead. For example, a fully automatic pH control system was installed in 1978 at one of the main treatment works supplying Glasgow[49]. Most of the water companies in England and Wales whose supplies failed to meet the lead standard gave legally binding undertakings to improve compliance by the end of 1995. The DWI's view is that a "significant improvement in compliance with 50 µg/l is expected in 1996". These data should be available by mid-1997.

## 3. Assessing exposure to lead from drinking water data

Despite the large number of tests carried out for lead in drinking water in the UK, there are several inherent problems in assessing the true extent of the lead in drinking water problem in the UK from the data published by the various inspectorates. The most obvious is that, although the published data show the extent of non-compliance with the 50 µg/l standard, they do not record whether or not the random samples for lead are taken from properties with lead pipes. Given the WRc's estimate that 34% of homes have some lead pipework, there is only a one in three chance of a random sample being taken from a home with lead pipes. If a high proportion of samples is taken from homes with lead pipework, measured levels of lead are likely to be on the high side, and conversely a larger proportion of samples taken from properties without lead will understate the extent of the problem. This point was raised by the WRc in its 1995 report to the Commission[50]:

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48 Chambers, E. Chief Executive, West of Scotland Water. Notes for Presentation to Symposium Lead in Drinking Water: Is there a Problem? 11 June 1996.

49 ibid.

50 Reference 38.

> At the time of sampling the pipe materials are not recorded. Consequently the lead concentration results received [from samples taken by water companies] cannot be taken to be fully representative of exposure to lead in drinking water

The type of sample taken also has an effect on results of lead levels. The degree of contamination of the water by lead depends, among other factors, on the length of time during which the water collected in the sample has been in contact with the lead pipework. Generally, the level of lead can be expected to increase if it has a long period of contact with the pipework as this provides more time for lead compounds to dissolve.

One of the uncertainties with random daytime samples, therefore, is that there is no information on when the water supply was last used, and thus how long the water has been "stagnating". If a water company technician samples a property during the day, it can be assumed that the occupier has been at home or, in the case of a business, working at the premises. It is therefore likely that the water supply will have been used fairly recently prior to sampling, and that the stagnation time will be shorter rather than longer. The Government has highlighted the fact that the UK standard for lead is more stringent than the standard set out in the drinking water Directive, which refers to a flushed sample[51]. However, it is clear that there are weaknesses even with the random daytime sample in assessing the representativeness of lead levels and therefore also of exposure.

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51 Department of the Environment/Welsh Office Memorandum to the Director General of Water Services *Water charges: The Quality Framework* 19 October 1993.

# IV Reducing lead in drinking water

## A. Government policy and advice

There are no specific commitments in the Labour Party's election manifesto on drinking water quality, although the manifesto does state that[52]:

> Labour will set new goals for improving the overall health of the nation which recognise the impact that poverty, poor housing, unemployment and a polluted environment have on health.

A section on drinking water quality in the Labour Party Policy Commission on the environment's 1994 report, *In Trust for Tomorrow*, states that[53]:

> Labour will ensure full compliance with European standards, as set out in the EU drinking water directive. We will also seek to improve standards for lead levels, in line with WHO guidelines.

Shortly after the publication of *In Trust for Tomorrow*, the then Opposition environmental protection spokesman, Chris Smith MP, also voiced concern over levels of lead in drinking water and was reported to have called for a major programme to replace lead piping "as a top priority"[54]. Given the balance of scientific evidence on the subject of lead, it would seem unlikely that a fundamental shift in policy from that of the former Government would take place.

The Conservative Government's view on lead was given in a written answer to Ian McCartney MP on 16th October 1996[55]:

> There is no blood lead level that is considered completely safe although there is no clear evidence of harm at level [sic] below 10 microgrammes per decilitre of blood. It is for this reason that the policy of successive Governments has been to reduce exposure to lead, from all sources, whenever reasonably practical.

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52 The Labour Party *New Labour Because Britain Deserves Better* April 1997.

53 *In Trust for Tomorrow* Report of the Labour Party Policy Commission on the Environment. The Labour Party, July 1994.

54 "Lead Levels in Water too High, says Labour" *Herald* 12 September 1994.

55 HC Deb 16 October 1996 c1035-1036W.

At the time of the privatisation of the water industry in 1989, the Government wrote to the water companies, setting out its policy on lead in drinking water, which essentially remained unchanged for the remainder of its term of office. The letter[56] stated that, as a result of a report assessing the neuropsychological effects of lead on children published by the Medical Research Council in 1988, "it would be prudent to continue to reduce the environmental lead to which children are exposed". The letter highlighted concerns raised by the Department of Health's independent expert advisory Committee on the Medical Aspects of the Contamination of Air, Soil and Water (CASW), which[57]:

> (i) expressed concern that some people may be exposed to concentrations of 100µg lead/l in drinking water, or higher concentrations;
>
> (ii) recommended that a limit of 50µg lead/l [the current standard] should be introduced as a practical measure to identify areas where further action to reduce lead concentrations is a priority;
>
> (iii) advised that the aim in the long term should be to achieve compatibility both with the criterion that in no more than 2% of the population of interest should the blood lead concentration exceed 25 µg/dl, and with a weekly intake of not more than 25µg lead per kg body weight in infants and children.

The Letter went on to state that the Chief Medical Officer "accepted and endorsed" the advice of the Medical Research Council's advisory group, the CASW and JECFA's PTWI for lead.

There was little development in terms of a co-ordinated strategy to tackle the problem of lead in drinking water until July 1996, when the Government announced that it intended to consult on proposals to include a new "Key Area" for *The Environment and Health* in its *Health of the Nation* strategy[58]. The consultation document proposed mobilising "individuals and groups to work together to improve environmental health" as so-called "health alliances" in five new target areas, one of which was lead in drinking water.

The overall objective of this element of the strategy was "To reduce high levels of lead in drinking water where these occur", with a target of ensuring that "zonal levels by 2005 are generally no more than half the current standard"[59]. The document highlighted the opportunities for health alliances in various sectors such as local authorities, housing

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56 Reproduced in *Guidance on Safeguarding the Quality of Public Water Supplies* Department of the Environment/Welsh Office HMSO London 1989.

57 The original JECFA PTWI for lead was set for adults only in 1972 and was 3 milligrams per person. In 1993, the PTWI of 25 µg/kg for children and infants was extended to all age groups.

58 Department of Health Press Notice 96/228 *Environment to be new Key Area: Health of the Nation - Fourth Anniversary Conference* 8 July 1996.

59 Department of Health/Department of the Environment *The Health of the Nation Consultative Document: The Environment and Health* November 1996.

associations, water suppliers and domestic consumers. However, many of these opportunities were re-statements of existing policy and there was no suggestion in the document of Government funding for any additional programmes for lead pipe removal. The document identified the role of the Government as the enforcer of drinking water quality standards, through the DWI, and noted that it would be "playing a full part" in the negotiations on the revision of the drinking water Directive, although it did not give any commitment to support the revised lead standard. The consultation process was launched in November 1996, and responses are now with the Departments. The Department of the Environment is in the process of discussing the *Environment and Health* Key Area with the new Ministers, in order to determine its future[60].

## B. The role of the water company

Although water companies have a general duty to ensure that the water they supply is wholesome, it cannot be assumed that the water company has supplied unwholesome water if the lead concentration exceeds the standard in the Regulations, because this is most likely to have been caused by the customer's own pipes. However, there is still a responsibility on water companies to take action to reduce lead concentrations at consumers' taps even if the problem is due to the consumer's plumbing. Under Regulation 24 of the 1989 Regulations companies are required to "treat the water in such a way as will, in its opinion, eliminate the prescribed risk or reduce it to a minimum". Government guidance to water companies[61] states that "Whenever practicable" a pH value of greater than 6.5 should be maintained in the water delivered to customers, "so that the water is not unduly aggressive towards these plumbing materials". This is aimed at ensuring that water generally does not become more than very slightly acidic, thus reducing its plumbosolvency.

At the time of privatisation, water companies were given instructions by the Government[62] that they should assume that there was a risk of failure to meet the lead standard in all their water supply zones, unless there was evidence to the contrary. Where there was no such evidence, companies were required to devise a year long monitoring programme to test lead levels in at least 20 samples from each supply zone, and only if all complied with the 50 µg/l standard, could it be assumed that there was no risk of drinking water exceeding the lead standard. This would mean that the measures set out in Regulation 24 and the guidance would not need to be followed for that *zone*.

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60 Department of Health 9 May 1997.
61 Reference 37.
62 ibid.

In practice reducing the plumbosolvency of water is achieved by dosing it with orthophosphate. This should aim to increase pH to at least 8.0 (slightly alkaline) at the customer's tap. Companies do not have to take such action "if the treatment is unlikely to achieve a significant reduction in the concentration of... lead", if the risk only relates to a small number of houses in a given supply zone or if the treatment is not "reasonably practicable".

In addition to the water company's duty to treat some waters to prevent against plumbosolvency, the company also has duties in respect of lead pipe replacement. Water companies are required to replace the lead communication pipe when a householder removes the section which he/she owns. This does not mean that the consumer has to replace all lead pipework in the property, merely the pipes which directly connect the drinking water tap to the water company's pipe.

More recent guidance to water companies in England and Wales on lead in drinking water was set out in a Memorandum from the Secretaries of State for the Environment and for Wales to the Director-General of Water Services on future environmental obligations for the water industry[63]:

> While the lead standard in the drinking water directive is under discussion [discussed in Chapter V], we consider the right course is to focus replacement of company pipes on locations where sampling indicates that there is a significant risk of high concentrations of lead on a regular basis. We suggest that the focus should initially be on locations in which concentrations regularly exceed 25-30 microgrammes/litre in unflushed samples..."

Where samples taken by water companies from customers' taps exceed the lead standard, the Government's guidance states that the company should notify both the customer and the local environmental health department of the result. The customer should also be advised to draw off water which has been lying in contact with the pipework before using the water for drinking or cooking. The amount of water needed to be drawn off in order to bring fresh water through from the main depends on the length of the supply pipes. The DWI recommends drawing off a washing-up bowlful of water, or more if the length of lead pipes exceeds 40 metres[64]. The water company or local environmental health department should be able to advise in individual cases where advice to draw off water is given to customers.

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63 Reference 51.

64 Department of the Environment/Welsh Office Drinking Water Inspectorate *Lead in Drinking Water - Have You Got Lead Pipes?* July 1995.

## C. The customer's role

Many consumers are unaware of the fact that the water company's responsibility for the water supply pipe extends only to the part of the network up to and including the stop valve, usually at the front curtilage of the property. This section of the supply pipe is referred to as the communication pipe. Beyond this, the pipework is the responsibility of the consumer. The bulk of the pipework in properties with lead pipes will therefore belong to the householder, rather than the water company.

The most obvious role for the water customer is to be aware of the presence of lead pipework in the home; it should be relatively straightforward for this to be ascertained. As lead pipes were used, at least in part, up until around the late 1960s, homes built after this time are unlikely to have lead pipes. Homes with kitchens which have been modernised since around 1970 are also likely to have had at least part of the lead pipework replaced with copper pipe, although this may not be the case for the entire length of the pipework.

If the householder is unsure about the age of the house or whether it has been modernised, simple checks can be carried out on the pipes supplying drinking water taps and those next to the stop valve to see if they are made of lead. Unpainted lead pipes are dull grey and are soft. If the pipes are painted, which is often the case, they can be gently scraped to reveal the colour of the metal beneath. In addition, lead pipes are usually thicker than copper pipes, and where lead pipes are connected, the joints are bulbous and elongated, in contrast to very compact joints in copper pipes. Some water pipes may be made of iron or plastic, but this is uncommon.

Advice on whether lead pipes are present can be obtained from the water company or local authority environmental health department. The DWI has also produced a leaflet on recognising lead pipes[65]. All water companies and environmental health departments should be prepared to sample individual properties for lead where lead pipes are present or are suspected to be present. Environmental health officers should also be able to offer customers appropriate health advice based on the results of analysis.

In 1995, the House of Lords Select Committee on the European Communities carried out an inquiry into drinking water[66]. It highlighted the "insufficient sense of urgency" with which the Government, local authorities, water companies and consumers have tackled the problems of lead pipe removal. The Committee attributed inaction by householders to a lack of an

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65 ibid.

66 House of Lords Select Committee on the European Communities Fourth Report *Drinking Water* 30 January 1996 HL 31 1995-96.

effective campaign to raise awareness of the risks of lead in drinking water and recommended that the Government and water companies launch such a campaign to address this problem among consumers.

The Committee also called for water companies to be statutorily obliged to advise, on an annual basis, householders in supply zones where lead concentrations exceed the prevailing level in the drinking water Directive and recommended that water companies also advise such customers of the company's duty to replace lead communication pipes to a property if the customer replaces the lead supply pipe.

## D. Grants for lead pipe replacement

For many years, means tested financial assistance has been available to householders from local authorities for lead pipe replacement under the house renovation grant system. Under section 604 of the *Housing Act 1985* an "adequate piped supply of wholesome water" is a statutory requirement of any house deemed to be fit for human habitation. It is not the case, however, that a house with lead pipes whose supply of water fails to comply with the lead standard in the *Water Supply (Water Quality) Regulations 1989* is automatically deemed unfit and therefore eligible for financial assistance. Department of the Environment guidance[67] states that:

> 9.0 In assessing the severity and extent of defects in respect of the water supply, regard may be had to the following regulations [the 1989 Regulations]... but failure to meet these would not, in itself, necessarily constitute grounds for unfitness.

The guidance goes on to suggest that analysis of the water supply may be undertaken where contamination of the water supply is suspected. However, as discussed in the previous Chapter, the results of analysis from a single property may vary greatly according to the way in which the water is sampled, with the likelihood of a first-draw sample yielding a higher lead concentration than the statutory random daytime sample. This may, in turn, affect the local authority's decision as to whether or not the supply is wholesome and therefore whether assistance will be offered for the replacement of pipes. The guidance does not state a preference for the samples which should be taken for establishing wholesomeness of the supply.

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[67] Department of the Environment *Circular 17/96 Private Sector Renewal: A Strategic Approach* The Stationery Office 5 December 1996

Another important aspect related to the issue of wholesomeness which is not addressed in the Department of the Environment guidance is whether, where the lead concentration can be reduced to less than the standard 50 µg/l by flushing the tap, it could be deemed that the water supply is both adequate and wholesome. Whilst the guidance does not suggest that this should be the case, it is possible that a local authority could argue this point.

Renovation grants under the system introduced in 1990 had no upper limit although caps were introduced in 1993. In 1996, the *Housing Grants, Construction and Regeneration Act* made renovation grants discretionary, rather than mandatory. Further information on housing renovation grants and on the *Housing Grants, Construction and Regeneration Bill* are provided in Library Research Papers 96/34 and 96/58.

In addition to renovation grants, financial help has also been made available to resident owners or tenants on income-related benefits under the Minor Works Assistance scheme since 1st September 1992[68]. Minor works grants have now been replaced with a Home Repair Assistance scheme, with wider scope and higher grant limits, although applicants have to be in a priority group such as those in receipt of means tested benefits. The home repair grant is discretionary, as was the old minor works grant, and is intended to complement the renovation grant with financial assistance for small scale repair works. Applications for a grant under the Home Repair Assistance scheme are considered on their individual merits by the local authority, although they should have guidelines to ensure a consistent approach. Local authorities are also permitted to target home repair grants for specific purposes, which may include a lead pipe replacement programme.

Calculations on the estimated costs per property of replacing lead supply pipes and internal lead plumbing in the UK were prepared by the WRc for a 1992 report for the Department of the Environment[69]. Drawing on these earlier figures in its 1995 report[70], the WRc estimated the average cost of replacement of the supply pipe, belonging to the owner of the property, to be 687 ECU (£880) and the cost of replacing internal cold water plumbing at 566 ECU (£809)[71]. This would amount to almost £1,700 per property. The *Disabled Facilities Grants and Home Repair Assistance (Maximum Amounts) Order 1996* currently limits the amount payable for home repair assistance to £2,000 per application, with a maximum limit of up to £4,000 per property in any three year period. This should be adequate for the replacement of lead pipework, based upon the average cost of replacement calculated by the WRc, but could be inadequate where the costs are higher than average. In 1993/94 in England and Wales 284 minor works grants were given for lead pipe replacement, totalling £171,378[72].

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68 Department of the Environment News Release No 489 *Assistance to Replace Lead Water Pipes Extended* 9 July 1992.

69 Water Research Centre *Economics of Lead Pipe Replacement DoE 2956-/1* May 1992.

70 Reference 38.

71 The 1995 report used an exchange rate of £0.78 to one ECU. The current value of the ECU is approximately £0.70. The cost for supply pipes is an average of estimates given for England and Wales, Northern Ireland and Scotland.

72 Reference 66.

In Scotland a discretionary repair grant is available for the replacement of lead pipes where tests on the water have been shown to exceed the current standard in the Scottish drinking water quality regulations (50 µg/l). The grant is means tested and provides for up to 90% financial assistance with the costs of the work[73]. In Northern Ireland the situation is generally the same as it was in England before the changes brought about by the *Housing Grants, Construction and Regeneration Act 1996*, with a renovation grant and minor works assistance.

One of the problems with discretionary grants is that they depend upon local authority resources. Councils are not required to give this assistance if, for example, their budgets have already been used up in paying for mandatory grants. In addition, the Government has made it clear in the past that renovation grants are not available in isolation for lead pipe replacement to make the water supply wholesome. Pipe replacement has to form a wider package of works to make a dwelling fit for human habitation[74]. As far back as 1983, the Royal Commission on Environmental Pollution[75] recommended that grants for lead pipe replacement should be freely available and that financial considerations should not get in the way of the pipe replacement programme.

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73 Scottish Office 18 April 1997.

74 Reference 68.

75 Royal Commission on Environmental Pollution 1983 *Lead in the Environment* Ninth Report, Cmnd. 8852.

# V Revision of the drinking water Directive

## A. The new lead standard

The European Commission adopted a proposal for the modification of the current drinking water Directive on 4 January 1995[76]; the proposal itself was published in May of that year[77,78]. As briefly discussed earlier, one of the main changes which the revision proposes to the existing Directive is the reduction of the lead limit from 50 µg/l to 10 µg/l, in line with the WHO's revised guideline, on the basis that[79]:

> ...the same evidence [that of the WHO] makes it clear that no higher parametric value could be supported, without compromising the health of infants, young children and pregnant women. Hence the parametric value for lead proposed is now at the upper acceptable limit for infants who are the group most at risk. The level allows for a high protection of other age groups.

The Commission proposes an interim lead standard of 25 µg/l to be achieved within five years of adoption, and that the 10 µg/l standard be achieved within 15 years. The DWI, which is representing the UK on the technical and scientific negotiations, understands that Member States broadly accept the proposed reductions in the lead standard, and that given the new scientific evidence which supports the lowering of the standard, it will be very difficult politically for any Member State to argue against 10 µg/l[80]. It also seems unlikely that the new UK Government would oppose the reduction in the lead standard, in view of its previous commitment to improve lead in drinking water in line with WHO guidelines.

## B. Achieving compliance

In written evidence to the House of Lords Select Committee inquiry into drinking water[81], Friends of the Earth quoted a scientific paper which estimated that there were "at least four million dwellings in England alone in which the average water lead concentration would exceed 10 micrograms per litre". Figures published by the DWI[82] show that almost one fifth

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76 Commission press release P/95/1 4 January 1995.
77 EC draft 7208/95 (COM(94)612 final), 17 May 1995.
78 *OJC 131* 30 May 1995 pp 5-24.
79 Reference 13.
80 Drinking Water Inspectorate 18 April 1997.
81 Reference 66.
82 Drinking Water Inspectorate *Nitrate, Pesticides and Lead 1991 to 1994* Department of the Environment/Welsh Office December 1996.

of the random daytime samples taken by water companies in England and Wales during 1994 exceeded the proposed new 10 µg/l standard. Table 1 shows trends in lead in drinking water between 1991 and 1994, where samples contained more than 10 µg/l.

**Table 1 Prevalence of lead in drinking water in England and Wales at concentrations above the proposed 10 µg/l standard.**

| | *percentage of samples with lead concentration in specific bandings (µg/l)* | | | | | |
|---|---|---|---|---|---|---|
| *year* | 11-20 | 21-30 | 31-40 | 41-50 | 51-100 | >100 |
| 1991 | 10.6 | 4.8 | 2.6 | 1.6 | 2.5 | 1.2 |
| 1992 | 8.9 | 3.9 | 2.1 | 1.3 | 2.0 | 0.9 |
| 1993 | 8.6 | 4.1 | 2.2 | 1.4 | 2.1 | 0.8 |
| 1994 | 7.9 | 4.1 | 2.2 | 1.5 | 2.2 | 0.9 |

Source: Drinking Water Inspectorate

The data demonstrate that there has been a general decline in the concentrations of lead recorded in samples which would have failed the proposed standard, had it been in force at the time. As with the compliance figures for the *current* lead standard, the DWI points out that the completion of new treatment processes for lead by the end of 1995 will have an effect on the numbers of samples exceeding the proposed new standard. However, the data must be considered in the light of the fact that they are random daytime samples, some of which will have been taken from homes with lead pipework, and some without. Comprehensive data on lead levels in water in homes with lead pipes has never been gathered in the UK, but the WRc stated in its 1995 report[83]:

> Data on the concentration of lead in water supplied through lead pipes has [sic] been provided from a very small proportion of the country. Of these samples... 9 to 41% [were] above 10 µg/l.

[83] Reference 44.

Much attention has been paid to how best to reduce lead levels in drinking water. The environmental journal *ENDS*[84] reported on the WRc's findings on compliance with the revised lead standard at the time of its publication:

> ...[the WRc] report for the Department of the Environment has concluded that...Treatments to reduce the plumbosolvency of water supplies by pH adjustment or addition of orthophosphate would only reduce lead levels to an average of 20µg/l. No other technologies are known to be effective.

The report itself went on to state that[85]:

> Therefore, compliance with a revised parametric value of 10 µg/l could only be guaranteed by the complete removal of lead from distribution systems and domestic plumbing. For strategic reasons it would be necessary for implementation of a rehabilitation programme to be phased over a period, e.g. 10 or 20 years, and interim measures might be needed in those properties awaiting renovation. Potential approaches in a transition period would be: central water treatment, point-of-use filters, and service pipe flushing (before drawing water for human consumption). A combination of these measures might be necessary to achieve a 10 µg/l limit.

The European Commission, in its Explanatory Memorandum on the proposed Directive concurred with this view, and it is for this reason that the Commission proposes the 15 year compliance period.

However, the need for lead pipe replacement at all has been called into question by different interpretations of the Directive, which if upheld, could undermine its effectiveness in relation to lead. These centre on two inter-related issues, namely how water samples should be taken in order to determine compliance, and whether samples which fail to meet the new standard because of the customer's own lead pipework are to be considered as breaches of the Directive.

On the first point, the Directive refers to "a representative sample of water drawn from the tap". It is unclear whether this means that every sample must comply with the new 10 µg/l standard, i.e. it is a MAC, or whether it would require samples averaged across a short period to comply. Furthermore, it does not specify whether samples should be flushed or random daytime samples. These factors are important because it is widely acknowledged that wholescale lead pipe replacement would be required to achieve compliance in every sample, whereas an average which allowed some samples to fail could more easily accommodate the higher concentrations of lead in samples taken from homes with lead pipe. In addition, compliance will be much easier for flushed samples because flushing draws water through directly from the main and there is therefore little opportunity for lead to dissolve into it.

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84 Reference 41.

85 Reference 44.

The Department of the Environment's view, in its evidence to the House of Lords Committee, was that it believed the Commission intended the new standard for lead to apply to a flushed sample, as is the case with the current Directive. The Water Services Association (WSA), which represents the main water and sewerage companies in England and Wales, also in evidence to the Committee, "noted that the Commission...appears to equate "representative" with an "average" level of lead as the basis for measuring compliance".

In it's own memorandum of evidence, North West Water agreed with the WSA, given that the revised standard was based upon the new WHO guideline, which in turn was derived from a weekly exposure to lead. Therefore, a short term mean would be more appropriate than a MAC for each individual sample. North West Water stated that it believed an averaged standard "could largely be achieved as a result of actions taken by the water undertakers themselves in introducing additional water treatment, such as phosphate dosing" and that wholescale lead pipe replacement would not therefore be required.

EUREAU, the union of national associations of water suppliers in Member States of the EU pointed out in a 1994 report to DGXI, the Commission's Environment Directorate, that a 10 µg/l MAC would affect not only lead pipework[86], but that lead can be leached from lead solder joints in copper pipes, brass taps and PVC pipes. However, this would be unlikely to affect flushed samples.

On the second, and perhaps more important point, Article 7(3) of the proposed Directive states that "Member States are deemed to have fulfilled their obligations" under the Directive if non-compliance with prescribed standards "is due to the domestic distribution system". The implications of this are quite profound. Given that a large proportion of water samples will exceed the proposed standard precisely as a result of the presence of domestic lead plumbing, compliance would be easy to achieve. The alternative would be to make no exclusions for domestic lead pipework and effectively force householders to replace their lead pipes (although even this would not be required if flushed samples were specified). The Explanatory Memorandum[87] to the proposed Directive makes it quite clear, however, that it would not force households to replace their lead pipes:

> It should be noted that the proposed Directive will not oblige individual householders to replace lead pipes within their property...However, in order to reap the full health benefits it is highly desirable that measures in the distribution and the domestic systems are taken in parallel.

This decision to stop short of requiring household pipe replacement appears to have been arrived at on the grounds of the subsidiarity of Member States[88]. It is strengthened by the argument that it would be unreasonable to prosecute a water company for failing to supply

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86 EUREAU *Implications to Water Suppliers and Householders of the New WHO Guidelines for Drinking Water Quality* Brussels, 8 July 1994.

87 Reference 13.

88 ibid.

wholesome water when it had in fact done so, but the customer's own lead pipes had subsequently contaminated the supply. It is understood from the DWI[89] that the European Parliament proposes amendments to this exclusion, which would confine it literally to just domestic households, and would mean that samples taken from buildings such as schools and hospitals would still have to comply with the new standard.

The House of Lords Committee came to a number of different conclusions on these issues. It did not support the view that compliance should be achieved by water treatment alone, and concluded that the aim of replacing all lead pipework was "implicit in the Commission's proposal for a lead limit of 10 µg/l measured at the customer's tap". It stated that consumers could not and should not be forced to replace their pipes, but recommended that:

> 90. The Government should put in place a national strategy for the replacement of all domestic lead piping over the same fifteen year period [as specified in the directive]. This will require a grant scheme for property owners on low incomes more generous than the present one...

Surprisingly, however, the Committee recommended that until lead pipes were replaced flushed samples at the customer's tap should be used in order to assess compliance with the Directive, and that a weekly average was an appropriate basis for determining compliance. It stated that flushed samples were preferable "in the interests of best informing the consumer about the actual risks incurred..." These conclusions are conflicting since there would be little point in removing lead pipes in order to achieve compliance if flushed samples were used. The fact that the Committee felt that flushed samples were representative of the actual risks from lead in drinking water was also unusual because of the general agreement that flushed samples under-state exposure to lead. If a flushed sample typically contains less than 10 µg/l of lead, then logically the "actual risks" would be very low, and therefore replacing pipes would be of little health benefit. The Government's response to the Committee's report on this point stated:

> 87.1 As explained above, current practice in the UK is to take a "random first draw daytime sample" when monitoring for lead. A flushed sample is likely to underestimate the level of lead exposure. Government is reluctant to accept this part of the recommendation on public health grounds.

The Government, however, went on to dismiss the Committee's call for a national strategy, citing the availability of Home Repair Assistance grants for eligible groups. It argued further that dosing of the water had a valid role to play in ensuring compliance:

> 83.3 Current indications are that it should not be necessary to remove all lead pipes for water to achieve the [WHO] guideline value [i.e. an average value rather than a maximum for each sample]. In most hard water areas, water is not plumbosolvent and the guideline value is probably already being largely achieved. Replacing lead pipework under such circumstances would have little benefit. As the Committee itself has pointed out, there is a balance to be drawn between risk and cost

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89 Reference 80.

Water treatment processes such as phosphate dosing are not without their own problems, however. In its 1992 report to the Department of the Environment, the WRc pointed out that treatments could:

> ...result in the destabilization of existing pipe deposits potentially leading to water discolouration and an increase in both the dissolved and particulate [lead] in the water." "90 per cent of the water companies surveyed felt that there were benefits to be gained by ceasing orthophosphate dosing for lead control. A rise in the phosphate level of the distributed water can result in problems with increased algal growth in stored water and an increase in mould growths, particularly in consumers' bathrooms...

The European Commission has initiated a study into appropriate monitoring programmes for lead, in order to be able to address the ambiguity of the current wording of the Directive. This work should be finished by the autumn of 1997[90] and should clarify the type of sample to be taken as well as any averaging period.

If lead pipe replacement is required, it is widely accepted that compliance could not be achieved by current "voluntary" rates of lead pipe replacement over the 15 year period which the Directive proposes. It is estimated that only around 1.5% of households replace their lead pipes every year[91]; the WRc assumes in its figures that 6,000 properties are demolished every year, half of which have lead communication and supply pipes. This rate of replacement would still result in 38% of homes having lead supply pipes by the year 2015[92]. The House of Lords Committee concluded that "At the present rate of voluntary replacement it would take another fifty to sixty years to remove all domestic lead piping in this country"[93].

## C. Costs of lead pipe replacement

The main assessment of the financial implications of compliance with the proposed lead standard is that made by the WRc for the Commission in 1995. The WRc considered a number of approaches to the problem:

(i) replacement of all lead over 10 years;

(ii) replacement of all lead over 20 years;

(iii) replacement of all distribution lead after 10 years and domestic plumbing after 20 years;

(iv) compliance with a value of 25 µg/l after 5 years via water treatment and 10 µg/l after 15 years by pipe replacement.

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90 ibid.

91 Reference 69.

92 Reference 38.

93 Reference 66.

The total costs of each option were estimated to be broadly similar, at approximately 13.5 billion ECU (around £19 billion) for the UK. However, when the likely financial savings and discounting rates[94] are applied, the true costs vary more considerably. Option iv most closely matches the timescales proposed by the Directive. The WRc estimates that this option would cost 7.6 billion ECU (approximately £10.9 billion), although a more recent estimate by the WRc put the figure at £7.2 billion[95]. 80% of these costs are attributable to the replacement of domestic lead pipework. With no current proposal to oblige Member States to replace household plumbing, it is unlikely that the full costs of replacement will be required, and the Explanatory Memorandum[96] to the Directive notes that, although the replacement of domestic plumbing is desirable on health grounds, "much of the cost of complying with the parametric value for lead can be considered optional".

The WRc is keen to point out that cost estimates for pipe replacement have many inbuilt uncertainties and should be considered in terms of their order of magnitude rather than as absolute values. Clearly, the final wording of the Directive will have a significant bearing on costs. The WSA argued, in evidence to the House of Lords Committee, that averaging the lead levels over a week could be achieved at "significantly lower cost" than the estimates for compliance in every sample. However, when pressed by the Committee to quantify the costs of either option, it was unsure, suggesting that savings of 20-30% could be possible.

## D. Effect on water bills

In 1993 OFWAT estimated that the burden of costs of lead pipe replacement which would fall on the water industry would be in the order of £2 billion for England and Wales[97]. OFWAT's National Customer Council estimates[98] that this would add approximately 3% or £8 a year to average household water bills for the duration of the replacement programme. Price levels for water charges are currently set by OFWAT in five yearly periods. The current period ends in the financial year 1999/2000 and so the effect of any increase in water bills will not be felt until at least 2000.

In practice OFWAT proposes that, despite the costs of quality improvements such as meeting the lead standard, water bills should fall in real terms at the next periodic review in 1999, which will set prices from 2000 to 2005. OFWAT's has stated[99] that its objective in the next periodic review will be:

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94 Assuming a discount rate of 8%.

95 Jackson, P. Principal Scientist, Drinking Water Chemistry, WRC. Notes for Presentation to Symposium Lead in Drinking Water: Is there a Problem? 11 June 1996.

96 Reference 13.

97 Office of Water Services *Paying for Quality: The Political Perspective* July 1993.

98 OFWAT National Customer Council Press Release ONCC/3/95 *Water Watchdog Calls for Cost-Effective Targeting of Further Action to Reduce Lead in Drinking Water* 28 June 1995.

99 Office of Water Services Press Notice 7/97 *Water Customers Should Expect a Reduction in Prices at the Next Review* 12 February 1997.

To establish a framework where the costs of any investment on quality obligations or on maintaining a balance between supply and demand can be accommodated within the constraints of likely future improvements in efficiency ie without bills rising in real terms.

## E. Progress of Directive and timetable

Although the new drinking water Directive was proposed in 1995, negotiations did not begin until the Irish Government's Presidency of the European Union in the second half of 1996. These negotiations are now continuing under the Dutch Presidency. It is understood from the DWI that Member States are largely in agreement with the revised value for the lead parameter in the new Directive but that the question over whether it applies to every water sample or whether it is to be viewed as an average has yet to be agreed upon.

A revised draft of the Directive to take on board these changes and the amendments proposed by the European Parliament may therefore be forthcoming by the end of 1997, if a common position can be agreed. This will also rely upon the Luxembourg Presidency, which takes over from the current Presidency, making it a priority to progress with the Directive. Even so, the final Directive us unlikely to be adopted until at least mid to late 1998, and Member States will, therefore, probably have until the end of 2003 to meet the 25 µg/l standard, and until 2013 to meet the 10 µg/l standard.

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| 96/58 | Housing Grants, Construction and Regeneration Bill | 01.05.96 |
| 96/35 | Water (Conservation and Consumer Choice) Bill | 06.03.96 |
| 96/34 | Housing Renovation Grants | 05.03.96 |
| 94/91 | Charging for water and the Periodic Review | 18.07.94 |
| 93/121 | Water fluoridation | 21.12.93 |