# Appendix H - Current Position of Human Health Risks from Lead (Pb) Exposure in the United Kingdom

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## 1. Abstract

- Lead paint-contaminated soil and dust are the most significant lead concerns in the UK, especially indoors where more lead-containing products are found. Hot spots also occur in London due to urbanization and a long history of industry, and Derbyshire due to its prominent historical mining presence.
- Since the 1960s, the UK government has taken legislative steps to ban products containing lead and to limit occupational exposure pathways.
- The PHE Lead Exposure in Children Surveillance System (LEICSS) program has been in place since 2010 to ensure rapid attention to children with elevated blood lead concentrations. BLC testing is done on a case-by-case basis, often as a part of general health investigations or when there is suspicion of lead poisoning. If an exceedance occurs (over 5 μg/dL), there is a protocol in place to ensure quick and effective mitigation and treatment. The UK has no formal process to identify and record population-level childhood lead exposure. In 2013, the UK National Screening Committee reviewed evidence in support of universal screening of blood lead concentrations in children aged 1-5 years old and recommended that universal testing should not be adopted. This lack of routine surveillance means that it is not known how many lead poisoning cases occur.
- There are a few piece-meal population-level studies about lead exposure in the UK, including the Avon Longitudinal Study of Pregnancy and Childhood. This study estimated that approximately 3-5% of children in the UK have blood lead concentrations (BLCs) over the screening level of 5 μg/dL. It also found that factors that increased the likelihood of exposure included living in areas of greater economic and social deprivation and residences built before 1972.


## 2. Introduction

Child health effects due to lead contamination are not common in the United Kingdom, though if exposure occurs, it is most often connected to lead paint-contaminated soil and dust (*Public Health Agency*, 2021). Contamination rates in the UK were the highest in the 1930s and 1940s, but the UK federal government acted throughout the 1960s-1990s, addressing the issue at its source. Currently, various UK agencies offer guidance on lead risk reduction for families and clinicians and use the

PHE Lead Exposure in Children Surveillance System (LEICSS) to ensure rapid attention to children with elevated blood lead concentrations. Due to the low rates of lead poisoning, the UK has no formal process to estimate or track population-level exposure and does not plan on implementing one. This report explores the UK's lead sources, exposure pathways, health risks, and surveillance systems to provide an international model for what can be done, or done differently, to address lead contamination at a national level. This report aims to provide insight into how one national management style is working and what can be learned from it in New Zealand.

## 3. Lead Sources, Sinks, and Exposure Pathways

Lead has been used in the United Kingdom (UK) and Europe for centuries, making it one of the most widely dispersed and persistent contaminants of concern in the country. Exposure to lead paint-contaminated soil and dust is the most impactful source of lead contamination (Mielke & Reagan, 1998), although other routes of exposure, such as air, water, and occupational exposure, play minor roles. Children, primarily under the age of 3, have the highest risk because object-to-mouth behavior is more common and their physiological uptake rate is higher due to their period of rapid development (Alexander et al., 1973). This section outlines the most significant lead concerns in the United Kingdom, primarily focusing on soil and dust.

### *2.1 Soil and Dust Contamination*

According to the British Geological Survey, the median concentration of lead in topsoil was 47 mg/kg in 2012. More specifically, the median Pb concentrations were 35 mg/kg (rural), 57 mg/kg (semi-urban), and 166 mg/kg (urban). Additionally, the upper 95% confidence limit of the 95th percentile of soil lead concentrations throughout the majority of England was 180 mg/kg, with higher confidence limits in urban areas (820 mg/kg) and in mineral-rich areas (2,400 mg/kg) (Johnson et al., 2012). This survey found that the distribution of Pb is often concentrated in the Greater London Authority (GLA) area, the area with the oldest and most intensive urbanization and industry (Figure 1)("London Earth," 2020). These hotspots in the U.K. point to the two primary sources of lead in soil and dust: (1) Lead paint and (2) the combination of mining, industry, and urbanization.

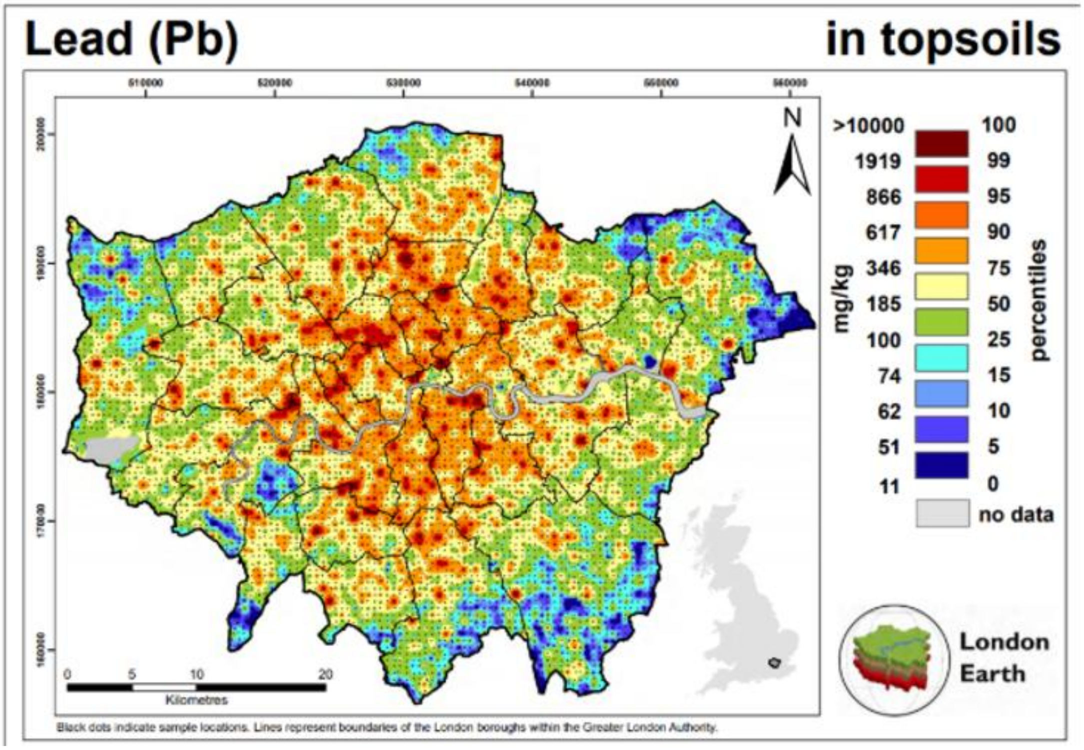


***Figure 1:*** *Lead concentration in London, UK ("London Earth," 2020).*

The lead-paint to soil and dust pathway is identified by the Lawther Working Party as the most significant contributor to lead exposure, especially for children (U.K Department of Health and Social Security, 1980). Lead is deposited in soil and dust through paint chip deterioration and flaking, unsafe construction methods (both indoors and outdoors), and weathering and Pb dissolution (only outdoors). Once in soil and dust, children and adults can be exposed to lead through inAgestion and inhalation pathways. This risk is especially high for children engaged in hand-to-mouth and pica behavior (Mielke & Reagan, 1998).

The UK differs from other countries in that the lead paint problem is, most importantly, an indoor exposure issue. Traditional UK houses are usually brick or stone, meaning that only a small amount of lead paint would have been used on the external structure. Instead, children are exposed to lead through indoor walls, wood, and metalwork paint that is old and peeling or has been resuspended during renovations (Homes and Antiques, 2022). This problem is extensive: around 55% of the UK housing stock was built before 1963. Up until this point, UK paint may have contained up to 50% lead by weight, meaning that more than half of UK homes were likely painted with lead paint (UK Health Security Agency, 2024)

The other key source of lead in the UK is the combination of historical mining, industry, and urbanization. These sources have created hot spots of lead concentrations in the UK (Figure 2). Historic lead mining in Derbyshire means that soil lead levels are 2,000 mg/kg or higher in 44% of homes. It is important to note that these values may not be as abnormal as expected due to the geological concentrations of Pb in the areas (Johnson et al., 2012). The other area of increased concentrations is in London. Eighteen percent of London homes exceed 2,000 mg/kg. As the centre of urbanization, London experienced a higher density of vehicle emissions, resulting in more historical leaded gasoline contamination (Johnson et al., 2013). A more dense housing scheme also means more lead-based house paint.

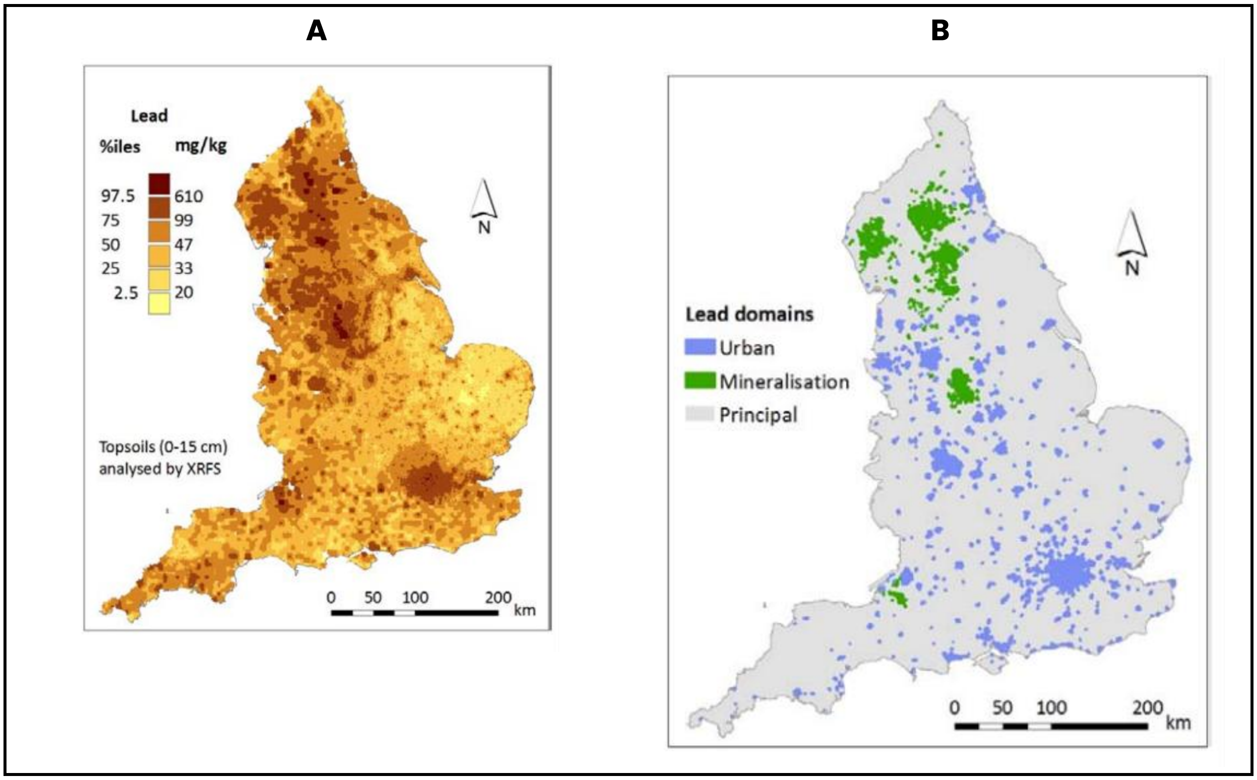


***Figure 2a and b:*** *Hot spots of Pb in soil in the UK (Johnson et al., 2012).*

Finally, it is important to remember in the soil and dust context that indoor and outdoor sources are moved around through human activity. House dust is at least 50% soil dust (Fergusson & Schroeder, 1985), meaning that lead particles from outdoor lead paint, historical leaded gasoline, and legacy mining emissions can be brought into the house, likely on shoes, pets, hands, and garden produce. Sources and routes of exposure cannot be compartmentalized but rather interact.

## 2.2 Air, Water, and Other Sources of Exposure

Air, water, and other sources of lead exposure are not large concerns in the UK. Dust and air-suspended particulates from gasoline—considered in many countries as a primary route of exposure—were determined not to be the source of lead burden in children (Haar & Aronow, 1974). Similarly, lead contamination of domestic water supplies is rare (*Public Health Agency*, 2021). The UK has banned lead in fittings and solders of pipes and treats 95% of its water, both of which prevent lead leaching (Lamb, 2020).

Another minor source of lead exposure is occupational exposure for contractors, steel welders, battery manufacturers, and plumbers. In these positions, the person may encounter lead sources discussed previously (*Public Health Agency*, 2021). Additionally, lead dust may be taken home on clothes from these workers, leading to para-occupational lead exposure (Kar-Purkayastha et al., 2012). Finally, some children may be exposed to lead by eating paint or sucking/chewing on painted objects (*Public Health Agency*, 2021). This problem is most severe in children exhibiting pica behavior.

## 3. Management of Lead in the United Kingdom

### *3.1 A Timeline of Lead Management in the United Kingdom*

The UK experienced the highest lead contamination concentrations, especially with lead paint, in the 1930s and 1940s (*Paint Toxicity and Risk*, 2019). Beginning in the early 1960s and continuing through the 1990s, the UK national government acted against lead contamination.

The first actions took place surrounding lead paint. In 1963, and again in 1974, the Paintmakers Association of Great Britain (now known as the British Coatings Federation) partnered with the national government to require labels for lead paint that contained more than 1.5% lead (1963) and 1% lead (1974). Efforts continued with the Environmental Protection Act of 1990, which established regulations on air pollution and waste on land. While not explicitly targeting lead, the Act's framework for identifying and regulating contaminated sites—including "duty of care" for waste producers and required local authority land inspections—was applied to manage and mitigate potential lead contamination (*Environmental Protection Act 1990*, 2025). This statutory framework for managing environmental pollutants was strengthened by the Environmental Protection Act of 1995 (*Environment Act 1995*, 2025).

Following these acts, the national government acted to explicitly ban products containing lead. Lead paint was banned in 1992, leaded fuel was made unavailable (except for a few specialist applications) in 1998, and the Water Supply (Water Fittings) Regulation of 1999 prohibited the use of lead in any part of the drinking water system (*Public Health Agency*, 2021). These actions were followed later by

European Bans. In 2009, the EU banned lead paints on toys (EU Toy Safety Directive), and in 2018, the EU banned all lead products sold to the public (*Public Health Agency*, 2021).

The UK national government has taken a few steps to further decrease lead exposure in the past 25 years. To address occupational exposure, the Control of Lead at Work Regulation (2002) and the accompanying Health and Safety Executive Approved Code of Practice were established. These pieces of legislation established BLL testing requirements for people who could be exposed in their workplace and put legal responsibility on employers to limit their workers' lead exposure.

Most recently, the UK has established a new framework—the Category 4 Screening Levels for Assessment of Land Affected by Contamination Framework (C4SLs Framework)—for addressing land affected by contamination. This framework works within the context of the Environmental Protection Act of 1990 and 1994, but makes modifications. This C4SLs Framework combines benchmark dose modelling and biokinetic modelling in a new model called CLEA (Contaminated Land Exposure Assessment) Modelling, established by the UK Environmental Agency and the Department for Environment, Food and Rural Affairs (DEFRA). This model employs the newest information on human health toxicology, exposure assessment, and normal ambient levels of environmental contaminants to establish contaminant concentrations in soil that are "acceptable levels of risk." This model applies to six different contaminants (including lead), and aims to prevent BLL levels above 5 μg/dL (rather than 10 μg/dL as before) (Department for Environment, Food and Rural Affairs, 2014b). In the model, depending on certain parameters such as land use, exposure per day, and the presence of home gardens, the amount of acceptable lead in soil concentrations ranges from 82 to 330 mg/kg in residential environments (Figure 3) (Department for Environment, Food and Rural Affairs, 2014a).

| Exposure parameters | LLTC | | pC4SLs ($mg.kg^{-1}$) | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | $ug.dL^{-1}$ | $\mu g.kg^{-1}$ (bw) $day^{-1}$ | Residential: With home grown prod. | Residential: Without home grown prod. | Allot-ments | Comm-ercial | $POS_{resi}$ | $POS_{park}$ |
| Withdrawn SGV | 10 | N/A[1] | 450 | 450 | 450 | 750 | - | - |
| pC4SL with exposure parameters as SR3 | 1.6 | 0.6 (ch)[3] | 82 | 130 | 30 | - | - | - |
| | | 0.29 (ad)[4] | - | - | - | 1100 | - | - |
| | | 0.57 (ad)[5] | - | - | - | 2200 | - | - |
| | 3.5 | 1.4 (ch)[3] | 190 | 310 | 70 | - | - | - |
| | | 0.63 (ad)[4] | - | - | - | 2300 | - | - |
| | | 1.3 (ad)[5] | - | - | - | 4800 | - | - |
| | 5[6] | 2.1 (ch)[3] | 200[6] | 300[6] | 74[6] | - | - | - |
| | | 0.89 (ad)[4] | - | - | - | 2700[6] | - | - |
| | | 1.8 (ad)[5] | - | - | - | 6000[6] | - | - |
| pC4SL with changes in exposure[2] | 1.6 | 0.6 (ch)[3] | 86 | 130 | 34 | - | 270 | 580 |
| | | 0.29 (ad)[4] | - | - | - | 1100 | - | - |
| | | 0.57 (ad)[5] | - | - | - | 2200 | - | - |
| | 3.5 | 1.4 (ch)[3] | 200 | 310 | 80 | - | 630 | 1300 |
| | | 0.63 (ad)[4] | - | - | - | 2300 | - | - |
| | | 1.3 (ad)[5] | - | - | - | 4800 | - | - |
| | 5[6] | 2.1 (ch)[3] | 210[6] | 330[6] | 84[6] | - | 760[6] | 1400[6] |
| | | 0.89 (ad)[4] | - | - | - | 2700[6] | - | - |
| | | 1.8 (ad)[5] | - | - | - | 6000[6] | - | - |

1. Former SGVs for lead were derived using empirically based methods, as opposed to CLEA.
2. Exposure parameters as described in Section 3.5.7 of main report.
3. Estimated intake that would lead to geomean blood lead concentration in 0 to 7 year old child using IEUBK.
4. Estimated intake that would lead to geomean blood lead concentration in adult using ALM.
5. Estimated intake that would lead to geomean blood lead concentration in adult using Carlisle & Wade.
6. The LLTC of 5 $ug.dL^{-1}$ is based on CDC's target blood lead concentration in children for all exposure to lead and therefore thus LLTC has been treated as a "threshold". Consequently, mean daily intake from non soil sources has been included in the CLEA model inputs for derivation of this C4SL.

***Figure 3:*** *Provisional C4SLs for lead derived using CLEA (Contaminated Land Exposure Assessment) modelling* (Department for Environment, Food and Rural Affairs, 2014a).

The national government also has current screening levels for lead in different environmental sinks (Table 1).

***Table 1:*** *Current Screening Levels for Lead in the United Kingdom.*

| Sink / Source | Regulatory Body | Standard | Citation |
|---|---|---|---|
| AIR | Uk Air Quality Standard Regulations | 0.5 µg/m³ | (Department of Environment, Food and Rural Affairs (DEFRA), 2025) |
| DRINKING WATER | Drinking Water Inspectorate (DWI) | 10 ug/L | (UK Health Security Agency, 2024c) |
| SOIL | Department for Environment, Food and Rural Affairs | 82-330 mg/kg* | (Department for Environment, Food and Rural Affairs, 2014a). |

In the realm of clean up, the UK national government does not clean up contaminated land but rather puts legal responsibility for remediation on those who caused or knowingly permitted the contamination. This cleanup regime was established by Part II A of the Environmental Protection Act of 1990. Though not explicitly providing cleanup support, the UK national government does advise on land contamination risk management through national reports. One of the first key reports was the Royal Commission Report on Lead in the Environment, written in 1983 (Royal Commission on Environmental Pollution, 1983). Since this one, many other guidance and action reports, including ones by DEFRA and the Royal Society for the Prevention of Accidents, have been published to guide on addressing lead paint in older homes, lead in children's playgrounds, lead in drinking water, occupational exposure to lead, lead toxicology, and other similar topics (*Public Health Agency*, 2021). These reports are found on UK governmental websites, including DEFRA and the Environmental Agency.

### *3.2 Blood Lead Levels*

As of 2021, the Blood Lead Concentration threshold in the UK is 5 μg/dL for children and pregnant people, and 10 μg/dL for adults. This change was prompted by scientific evidence of adverse effects of lead on children with blood lead concentrations (BLC) below 10 μg/dL, the former threshold. The threshold was also amended to reduce inequality; exposure to high levels of lead in England is associated with multiple facets of inequality, including economic, health, age, and ethnicity dimensions. It is important to note that DEFRA also concluded that a BLC of less than 5μg/ is still associated with adverse health effects (Public Health England, 2021).

In the UK, an estimated two percent of children have an elevated BLC over 5 μg/dL (*Public Health Agency*, 2021), though this number has been challenged by a study that claims the percentage is 3-5% (Public Health England, 2012). In this SliC Study—one of the few surveys that has been conducted in the UK—a total of 46 cases of lead poisoning were reported over a two-year study period. Some factors that increased the likelihood of exposure included living in areas of greater economic and social deprivation (*Public Health Agency*, 2021) and a postcode property age pre-1972 (Public Health England, 2012).

Overall, studies have shown that non-occupational lead poisoning is rare. Some piece-meal studies have identified a small number of children with elevated BLLs—usually due to lead-paint contaminated soil—but little else is known (*Public Health Agency*, 2021). The UK has no formal process to identify and record population-level childhood lead exposure. This lack of routine surveillance means that it is not known how many lead poisoning cases occur.

## 4. Monitoring Programs and Intervention

### *4.1 National Public Health and Clinical Guidance*

In the UK, national guidance primarily consists of public health and clinical advice for lead risk reduction. For instance, the Department for Environment, Food, and Rural Affairs provides public health advice on when to conduct soil and water tests, what home sampling methods to use, and what other general Pb information families should know (UK Health Security Agency, 2024a).

The National Poisons Information Service also exists to provide advice for clinicians on how to proceed with cases of elevated blood lead levels. Through this service, medical professionals can consult with toxicology consultants about how to proceed with their cases (*Public Health Agency*, 2021). The recommendations for clinical and public health management by Blood lead concentration are included below (Figure 4).

| Blood lead concentration | Clinical management | Public health management |
|---|---|---|
| ≥0.1μmol/L (≥2μg/dL) to <0.24μmol/L (<5μg/dL) | Identify and remove/abate sources of exposure<br><br>Correct calcium and iron deficiency<br><br>Repeat BLC testing 4 weeks after removal from exposure | Notification not indicated unless concerned about a wider public health risk e.g. cluster of cases/family associated with same exposure source |
| ≥0.24μmol/L (≥5μg/dL) to <2.4μmol/L (<50μg/dL) | Actions as above, and if symptomatic discuss with NPIS (as rarely may benefit from chelation) | Public Health Intervention Concentration. Voluntary notification to Public Health England recommended for public health response:<br><br>- Systematic identification of potential exposure sources and pathways by questionnaire and environmental assessment of e.g. home, school, care settings<br><br>- Advice on lead source removal/abatement to interrupt exposure pathways<br><br>- Consideration if other vulnerable individuals (children, pregnant women) at risk<br><br>- Provide advice on further BLC monitoring following removal from exposure<br><br>- Surveillance to expedite response, and to describe case epidemiology to inform further public health interventions |
| ≥2.4μmol/L (≥50μg/dL) to <3.3μmol/L (<70μg/dL) and non-encephalopathic | Identify and remove/abate sources of exposure<br><br>Correct calcium and iron deficiency<br><br>Discuss with NPIS<br><br>Consider hospital admission<br><br>Consider chelation<br><br>Repeat BLC testing 1 week after treatment | |
| ≥3.3μmol/L (≥70μg/dL) or encephalopathic | Discuss with NPIS<br><br>Identify and remove/abate sources of exposure<br><br>Correct calcium and iron deficiency<br><br>Admit to High Dependency Unit if encephalopathic<br><br>Chelation using dimercaptosuccinic acid (DMSA, succimer), or sodium calcium edetate under expert advice<br><br>Monitor BLC according to expert advice | |

***Figure 4:*** *Recommended actions for both clinical and public health management of different Blood lead concentrations* (*Public Health Agency*, 2021).

### *4.2 National and European Screening*

The UK has established some lead surveillance protocols and interventions for drinking water, air, and blood lead levels.

The UK runs a drinking water lead testing program for water companies in England and Wales that is carried out by the Drinking Water Inspectorate. In 2023, 12,827 lead tests were conducted in England, with only 45 showing failures to meet the Drinking Water Standard of 10 μg/dL (0.35%). There is also a lead pipe replacement program that is a part of a collective goal of UK water companies to be lead-pipe free by 2050. In 2023, 30,910 lead pipe replacements occurred (Drinking Water Inspectorate, 2023).

The Department for Food, Environment and Rural Affairs oversees national air quality monitoring networks, including the Automatic Urban and Rural Network (AURN)—located across major urban centers, suburban locations, rural and remote locations, and some industrial areas—and the London Air Quality Network, collating data in 30 London boroughs (Environmental Agency, 2024). Lead in outdoor air is not a primary exposure pathway unless a person is living near a point-source emitter, with reported mean lead air concentrations in rural and industrial sites at less than 0.005 $\mu g/m^3$ but up to 0.09 μ $\mu g/m^3$. Lead deposition onto soil is a more important concern (UK Health Security Agency, 2024d).

There is no universal blood lead concentration testing in the UK. In 2013, the UK National Screening Committee reviewed evidence in support of universal screening of blood lead concentrations in children aged 1-5 years old and recommended that universal testing should not be adopted in the UK (*Public Health Agency*, 2021). Instead, the UK has the PHE Lead Exposure in Children Surveillance System (LEICSS).

LEICSS is a national surveillance system coordinated by the UK Health Security Agency (UKHSA). BLC testing is done on a case-by-case basis, often as a part of general health investigations or when there is suspicion of lead poisoning (such as pica behavior present or a known exposure). If a test is given and an exceedance occurs (over 5 μg/dL), specialist laboratories that are conducting the tests notify the Health Protection Teams (HPTs). The HPTs then assign the case to a lead clinician who advises local clinicians and the family on next steps (UK Health Security Agency, 2024b). This advice can include how to identify potential sources of exposure and whether to do chelation therapy. The HPT can also be directly contacted on government websites (*Public Health Agency*, 2021). In 2023, a total of 226 cases were reported to UKHSA, with the median of lab-detected cases 0.39 umol/L. The highest detection rate was in children aged 1 to 4, and specifically for male children. The detection rate in England was 21 cases per million, with the most common exposures reported as soil (67%) and paint (44%) (Figure 5). The exposure route was determined by the Enhanced Surveillance Questionnaire (ESQ), developed in 2021 to scope out potential lead sources. The detection rate has increased, but this is likely due to a bias in case ascertainment rather than a reflection of accurate incidence/prevalence (Figure 6).

| Years in which cases were reported | Number of cases with a completed ESQ or look-back questionnaire, out of total cases* (%) | Paint source (%) | Soil source (%) | Imported spices or food (%) | Traditional medicines (%) |
|---|---|---|---|---|---|
| 2021 to 2023* | 236 out of 507 (47%) | 103 (44%) | 157 (67%) | 32 (14%) | 19 (8%) |
| 2015 to 2022** | 347 out of 542 (64%) | 150 (43%) | 103 (29%) | 20 (6%) | 14 (4%) |

***Figure 5:*** *Percentage of cases with identified paint sources, 2015-2023 (UK Health Security Agency, 2024b).*

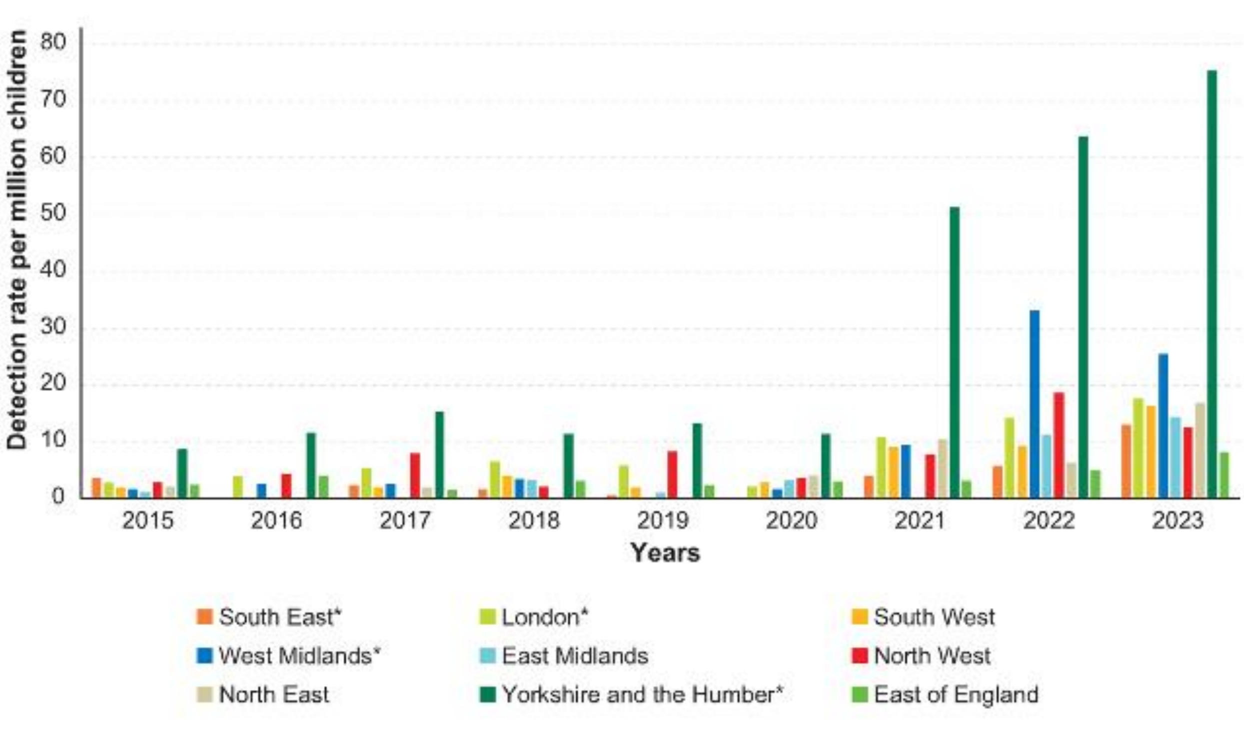


***Figure 6:*** *Detection rate of lead per millions of children by location in the UK (UK Health Security Agency, 2024b).*

The LEICSS program was initiated in 2010 by the Surveillance of elevated blood Lead in Children (SLiC) study, a joint project between the British Pediatric Surveillance Unit and the Health Protection Agency. SLiC authors recommended a surveillance system as a part of timely public health management of lead, so the pilot system began in 2014. LEICSS was permanently implemented in 2016. The data from LEICSS is fed into the Environmental Public Health Surveillance System, operated by UKHSA, which tracks and reports public health concerns (UK Health Security Agency, 2024b).

The SLiC study began in 2010 to track cases of lead poisoning. It is important to note that this study does not represent the average BLCs in children across the UK. Children are usually only tested due to exposure history (pica behavior present or contact with someone else with elevated levels) or clear signs or symptoms (Public Health England, 2012). While this system ensures rapid attention for kids with elevated levels, it is unlikely that parents with kids under 60 µg/dL would actively seek medical advice because there would be no triggering symptoms. Thus, there are no recent estimates of population-level exposure in England.

While there are no recent datasets on the average BLC in the UK, there is older BLC information from cohort studies in the late 1970s, including the European Community Screening Program and the UK Avon Longitudinal Study of Pregnancy and Childhood.

Screening campaigns for lead pollution took place in 1979-1980 following European Community Directive 77/312/EEC (Commission of the European Communities, 1977). In this study, 50 people per one million inhabitants were tested, including (1) at least 100 persons in major urban areas with a population above half a million, (2) at least 100 persons exposed to significant sources of lead pollution, and (3) critical groups at special risk. The results showed that the average inner-city blood lead concentration was 12.8 μg/dL, and the outer-city blood lead concentration was 11 μg/dL. People in urban areas had higher BLL, likely due to increased average air lead concentrations (Quinn, 1985). Additionally, 3.1 per cent of the inner-city population and 1.9 per cent of the outer-city population were estimated to have a blood lead concentration greater than 25 μg/dL (Department of the Environment, 1983). This study was not exclusive to the UK, but is rather representative of BLCs across Europe in the late 1970s and early 1980s.

The other cohort study conducted in the UK was the Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC), a population-based cohort study investigating environmental and genetic influences on the health, behaviour, and development of children. All births in the former Avon Health Authority area with an expected date of delivery between 1st April 1991 and 31st December 1992 were eligible for the ALSPAC, resulting in a total cohort of 14,062 surviving live births. The social and demographic characteristics of these 14,062 children were like those found in UK national census surveys. Of these births, 10% were randomly selected to be invited to be tested for lead at 30 months. A total of 585 infants were sampled, revealing a mean of 3.44 μg/dL. Additionally, 27% had BLC above 5 μg/dL, and 5.4% of the children had a blood lead concentration >10 μg/dL. These same 585 children took a Standard Assessment Test at 7-8 years to see if BLC had an impact on behavioral and neurological development. The study concluded that at the threshold of 10 μg/dL, scores began to deteriorate (Golding et al., 1998). Since the ALSPAC study, there have not been any population-level studies of BLCs in the UK.

### *4.3 Academic Research*

Recent research published on Web of Science surrounding human risks from lead exposure is limited in the United Kingdom over the past five years. Most of the lead research focuses on Pb isotopes, Pb concentrations in the Earth's crust, the health effects on non-human animals, or Pb impacts modeled on a cellular level. Many papers also come up from "New England" in the United States or are written by authors from the UK but pull from US national surveys. Taking these considerations in mind, I used the search query: (Department for Environment, Food and Rural Affairs, 2014), focusing on the period 2023-2025. 69 papers showed up with this search query. After combing for relevance, I found three papers. To expand further, I then changed the period to 2020-2025. There were 173 results, and I sorted for relevance, adding 9 to the table (Table 2).

**Table 2:** Recent national and regional lead surveys in the UK (2015-2025).

| Title | Study Location | Year | Reference |
|---|---|---|---|
| Using oral bioaccessibility measurements to refine risk assessment of potentially toxic elements in topsoils across an urban area | Belfast, Northern Ireland | 2024 | (Cocerva et al., 2024) |
| Urban vegetable contamination – The role of adhering particles and their significance for human exposure | Urban soils in Sweden, Denmark, Spain, the UK, and the Czech Republic | 2023 | (Augustsson et al., 2023) |
| Predictive modeling of indoor dust lead concentrations: Sources, risks, and benefits of intervention | England, U.S., and Australia | 2023 | (Dietrich et al., 2023) |
| Investigating the Geochemical Controls on Pb Bioaccessibility in Urban Agricultural Soils to Inform Sustainable Site Management | Newcastle, England, UK | 2020 | (Entwistle et al., 2020) |

| | | | |
|---|---|---|---|
| Exercise, Urban Food Production, Preparation and Consumption: Implications, Benefits and Risks to Grow-Your-Own (GYO) Gardeners | Any urban gardener in the UK | 2022 | (Stubberfield et al., 2022) |
| Health Risk Assessment of Lead in Soils from an Historical Industrial Site in North-East England | Newcastle, England, UK | 2022 | (Ma & Dean, 2022) |
| Lead and Mercury in historical books and their contribution to dust contamination | Two book collections in southwest England | 2023 | (Turner, 2023) |
| Determinants of blood and saliva lead concentrations in adult gardeners on urban agricultural sites | Newcastle, England, UK | 2021 | (Bramwell et al., 2022) |
| Lead in painted surfaces and dusts from rented urban properties (Plymouth, UK) | Plymouth, UK | 2023 | (Tooms et al., 2023) |
| Lead and chromium in European road paints | Merseyside, S Wales, SW England, and N Yorkshire | 2023 | (Turner & Filella, 2023) |
| Heavy metals and metalloids concentrations across UK urban horticultural soils and the factors influencing their bioavailability to food crops | UK-wide | 2021 | (Crispo et al., 2021) |
| Lead exposure in children | UK-wide | 2022 | (Roberts et al., 2022) |

## 5. References


Alexander, F. W., Delves, H. T., & Clayton, B. E. (1973). *The uptake and excretion by children of lead and other contaminants* (Proceedings of the International Symposium: Environmental Health Aspects of Lead, pp. 319–331). Commission of the European Communities.

Augustsson, A., Lundgren, M., Qvarforth, A., Engström, E., Paulukat, C., Rodushkin, I., Moreno-Jiménez, E., Beesley, L., Trakal, L., & Hough, R. L. (2023). Urban vegetable contamination—The role of adhering particles and their significance for human exposure. *Science of The Total Environment*, *900*, 165633. https://doi.org/10.1016/j.scitotenv.2023.165633

Bramwell, L., Morton, J., Harding, A.-H., Lin, N., & Entwistle, J. (2022). Determinants of blood and saliva lead concentrations in adult gardeners on urban agricultural sites. *Environmental Geochemistry and Health*, *44*(10), 3493–3513. https://doi.org/10.1007/s10653-021-01095-7

Cocerva, T., Robb, M., Wong, A., Doherty, R., Newell, J., Ofterdinger, U., Carey, M., Cave, M., & Cox, S. F. (2024). Using oral bioaccessibility measurements to refine risk assessment of potentially toxic elements in topsoils across an urban area. *ECOTOXICOLOGY AND ENVIRONMENTAL SAFETY*, *276*, 116293. https://doi.org/10.1016/j.ecoenv.2024.116293

Commission of the European Communities. (1977). Council Directive of 29 March 1977 on Biological Screening of the Population for Lead. *Official Journal L105, The Commission, Luxembourg*, 10.

Crispo, M., Dobson, M. C., Blevins, R. S., Meredith, W., Lake, J. A., & Edmondson, J. L. (2021). Heavy metals and metalloids concentrations across UK urban horticultural soils and the factors influencing their bioavailability to food crops. *Environmental Pollution*, *288*, 117960. https://doi.org/10.1016/j.envpol.2021.117960

Department for Environment, Food and Rural Affairs. (2014). *Appendix H Provisional C4SLs for Lead* (pp. 1–53).

Department for Environment, Food and Rural Affairs. (2014b). *SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination—Policy Companion Document* (pp. 1–18).

Department of Environment, Food and Rural Affairs (DEFRA). (2025). *Heavy Metals Network* (UK; United Kingdom). UK AIR; Department for Environment, Food and Rural Affairs (Defra), Nobel House, 17 Smith Square, London SW1P 3JR helpline@defra.gsi.gov.uk. https://uk-air.defra.gov.uk/networks/network-info?view=metals

Department of the Environment. (1983). *European Community Screening Programme for Lead: United Kingdom Results for 1981* (Pollution Report No. 18).

Dietrich, M., Barlow, C. F., Entwistle, J. A., Meza-Figueroa, D., Dong, C., Gunkel-Grillon, P., Jabeen, K., Bramwell, L., Shukle, J. T., Wood, L. R., Naidu, R., Fry, K., Taylor, M. P., & Filippelli, G. M. (2023). Predictive modeling of indoor dust lead concentrations: Sources, risks, and benefits of intervention. *Environmental Pollution*, *319*, 121039. https://doi.org/10.1016/j.envpol.2023.121039

Drinking Water Inspectorate. (2023). *Drinking Water 2023: The Chief Inspector's report for drinking water in England*. Retrieved July 14, 2025, from https://dwi-production-files.s3.eu-west-2.amazonaws.com/wp-content/uploads/2024/08/07103814/E03067866_DWI-Public-water-supplies-in-England-2023_Accessible_v2-1.pdf

Entwistle, J., Bramwell, L., Wragg, J., Cave, M., Hamilton, E., Gardner, A., & Dean, J. R. (2020). Investigating the Geochemical Controls on Pb Bioaccessibility in Urban Agricultural Soils to Inform Sustainable Site Management. *Geosciences*, *10*(10), 398. https://doi.org/10.3390/geosciences10100398

*Environment Act 1995*. (2025). [Text]. Statute Law Database. https://www.legislation.gov.uk/ukpga/1995/25/contents

Environmental Agency. (2024). *Monitoring ambient air: Monitoring strategy*. GOV.UK. https://www.gov.uk/guidance/monitoring-ambient-air-monitoring-strategy

*Environmental Protection Act 1990*. (2025). [Text]. Legislation.Gov.Uk; Statute Law Database. https://www.legislation.gov.uk/ukpga/1990/43/contents

Fergusson, J. E., & Schroeder, R. J. (1985). Lead in house dust of Christchurch, New Zealand: Sampling, levels and sources. *Science of The Total Environment*, *46*(1), 61–72. https://doi.org/10.1016/0048-9697(85)90283-9

Golding, J., Smith, M., Delves, H. T., & Taylor, H. (1998). *The ALSPAC study of lead in children* (No. R9; IEH Report on Recent UK Blood Lead Surveys, pp. 35–39).

Homes and Antiques. (2022, November 11). *British house styles across the ages*. https://www.homesandantiques.com/interiors/homes/discover-500-years-of-british-homes

Haar, G. T., & Aronow, R. (1974). New information on lead in dirt and dust as related to the childhood lead problem. *Environmental Health Perspectives*, *7*, 83–89. https://doi.org/10.1289/ehp.74783

Johnson, C., Ander, L., Cave, M., & Palumboe-Roe, B. (2012). *Technical Guidance Sheet on normal levels of contaminants in English soils*.

Johnson, C., Ander, L., Cave, M., & Palumboe-Roe, B. (2013). *Technical Guidance Sheet on normal levels of contaminants in English soils*.

Kar-Purkayastha, I., Balasegaram, S., Sen, D., Rehman, A. J., Dargan, P. I., Johnston, D., Raynal, A., Wood, D. M., Abrahams, A., Kamanyire, R., Murray, V., & Cordery, R. (2012). Lead: Ongoing public and occupational health issues in vulnerable populations: a case study. *Journal of Public Health*, *34*(2), 176–182. https://doi.org/10.1093/pubmed/fdr077

Lamb, N. (2020). Taking the lead: An insight into orthophosphoric acid treatment for lead control in the UK drinking water industry. *Perspectives in Public Health*, *140*(3), 133–134. https://doi.org/10.1177/1757913920916148

London Earth: London soil geochemistry map — lead (Pb). (2020). *British Geological Survey*. https://www.bgs.ac.uk/download/london-earth-london-soil-geochemistry-map-lead-pb/

Ma, R., & Dean, J. R. (2022). Health Risk Assessment of Lead in Soils from an Historic Industrial Site in North-East England. *ResearchGate*. https://doi.org/10.3390/separations9010012

Mielke, H. W., & Reagan, P. L. (1998). Soil is an important pathway of human lead exposure. *Environmental Health Perspectives*, *106*(suppl 1), 217–229. https://doi.org/10.1289/ehp.98106s1217

*Paint Toxicity and Risk*. (2019). https://www.buildingconservation.com/articles/lead-paint/lead-paint.htm

*Public Health Agency. (2021). Information on Lowering of the Lead Intervention Concentrations for children and pregnant women in England*. Retrieved July 10, 2025, from https://www.rcpch.ac.uk/sites/default/files/2021-09/RCPCH%20Information%20v1.0%20%28004%29.pdf

Public Health England. (2012). *SLiC study of blood lead concentrations in children: 2010 to 2012*. Retrieved July 14, 2025, from https://assets.publishing.service.gov.uk/media/5bd32b66ed915d788c99f1f2/SLiC_final_report_v3.pdf

Public Health England. (2021). *Evaluation of whether to lower the public health intervention concentration for lead exposure in children*.

Quinn, M. J. (1985). Factors affecting blood lead concentrations in the UK: Results of the EEC blood lead surveys, 1979-1981. *International Journal of Epidemiology*, *14*(3), 420–431. https://doi.org/10.1093/ije/14.3.420

Roberts, D. J., Bradberry, S. M., Butcher, F., & Busby, A. (2022). *Lead exposure in children*. https://doi.org/10.1136/bmj-2020-063950

Royal Commission on Environmental Pollution. (1983). *Ninth Report Lead in the Environment Presented to Parliament*. Retrieved July 10, 2025, from https://library2.nics.gov.uk/pdf/drd/2016/0476.pdf

Shepherd, T. J., Dirks, W., Roberts, N. M. W., Patel, J. G., Hodgson, S., Pless-Mulloli, T., Walton, P., & Parrish, R. R. (2016). Tracing fetal and childhood exposure to lead using isotope analysis of deciduous teeth. *Environmental Research*, *146*, 145–153. https://doi.org/10.1016/j.envres.2015.12.017

Stubberfield, J., Troldborg, M., Ander, L., Crout, N., Young, S. D., & Hough, R. L. (2022). Exercise, Urban Food Production, Preparation and Consumption: Implications, Benefits and Risks to Grow-Your-Own (GYO) Gardeners. *Agronomy-Basel*, *12*(1). https://doi.org/10.3390/agronomy12010181

Taylor, C. M., Humphriss, R., Hall, A., Golding, J., & Emond, A. M. (n.d.). *Balance ability in 7- and 10-year-old children: Associations with prenatal lead and cadmium exposure and with blood lead levels in childhood in a prospective birth cohort study | BMJ Open*. Retrieved July 16, 2025, from https://bmjopen.bmj.com/content/5/12/e009635

Tooms, S., Stokes, A., & Turner, A. (2023). Lead in painted surfaces and dusts from rented urban properties (Plymouth, UK). *Environmental Pollution*, *316*, 120503. https://doi.org/10.1016/j.envpol.2022.120503

Turner, A. (2023). Lead and mercury in historical books and their contribution to dust contamination. *Journal of Hazardous Materials*, *458*, 131981. https://doi.org/10.1016/j.jhazmat.2023.131981

Turner, A., & Filella, M. (2023). Lead and chromium in European road paints. *Environmental Pollution*, *316*, 120492. https://doi.org/10.1016/j.envpol.2022.120492

U.K Department of Health and Social Security. (1980). *Lead and Health: A Report of the Working Party on Lead in the Environment*. HMSO.

UK Health Security Agency. (2024a). *Lead: Environmental and public health intervention*. GOV.UK. https://www.gov.uk/government/publications/lead-poisoning-advice-for-the-public-and-healthcare-professionals/lead-environmental-and-public-health-intervention

UK Health Security Agency. (2024b). *Lead Exposure in Children Surveillance System (LEICSS) annual report, 2024*. GOV.UK. https://www.gov.uk/government/publications/lead-exposure-in-children-surveillance-reports-from-2021/lead-exposure-in-children-surveillance-system-leicss-annual-report-2024

UK Health Security Agency. (2024c). *Lead: Information for the public*. GOV.UK. https://www.gov.uk/government/publications/lead-poisoning-advice-for-the-public-and-healthcare-professionals/lead-information-for-the-public

UK Health Security Agency. (2024d). *Lead: Toxicological overview*. GOV.UK. https://www.gov.uk/government/publications/lead-properties-incident-management-and-toxicology/lead-toxicological-overview

Water Regs UK. (2025). *Water Regs UK Limited Home*. Water Regs UK Limited. https://www.waterregsuk.co.uk/

Wragg, J., Broadway, A., Cave, M. R., Fordyce, F. M., Palumbo-Roe, B., Beriro, D. J., Farmer, J. G., Graham, M. C., Ngwenya, B. T., & Bewley, R. J. F. (2017). Linkage between solid-phase apportionment and bioaccessible arsenic, chromium and lead in soil from Glasgow, Scotland, UK. *Earth and Environmental Science Transactions of The Royal Society of Edinburgh*, *108*(2–3), 217–230. https://doi.org/10.1017/S1755691018000762