

**Report of an Inter-Agency Group on the Silvermines Area of  
County Tipperary**

**May 2018**



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## ABBREVIATIONS

|                   |  |
|-------------------|--|
| AIM               | Animal Identification and Movement                           |
| BLL               | Blood Lead Level   |
| BMDL              | Benchmark Dose Level   |
| bw                | body weight  |
| CDC               | Centers for Disease Control and Prevention                   |
| DAF               | Department of Agriculture and Food                           |
| DAFM              | Department of Agriculture, Food and the Marine               |
| DAFRD             | Department of Agriculture, Food and Rural Development        |
| DCCA              | Department of Communications, Climate Action and Environment |
| DCMNR             | Department of Communications, Marine and Natural Resources   |
| DED               | District Electoral Division                                  |
| DEHLG             | Department of Environment, Heritage and Local Government     |
| DES               | Department of Education and Skills                           |
| dl                | decilitre  |
| DMNR              | Department of Marine and Natural Resources                   |
| EFSA              | European Food Safety Authority                               |
| EHS               | Environmental Health Service                                 |
| EMD               | Exploration and Mining Division                              |
| EPA               | Environmental Protection Agency                              |
| FBO               | Food Business Operator                                       |
| FSAI              | Food Safety Authority of Ireland                             |
| GTMF              | Gortmore Tailings Management Facility                        |
| HSE               | Health Service Executive                                     |
| IAG               | Inter-Agency Group   |
| IGS               | Implementation Group for Silvermines                         |
| kg                | kilogram   |
| L                 | Litre  |
| mg                | milligram  |
| ML                | Maximum Level  |
| MWHB              | Mid-Western Health Board                                     |
| MWMF              | Mine Waste Management Facility                               |
| NALA              | National Adult Literacy Agency                               |
| NRCP              | National Residue Control Plan                                |
| NTCC              | North Tipperary County Council                               |
| Pb                | Lead   |
| PbCO <sub>3</sub> | Cerussite  |
| ppb               | parts per billion  |
| ppm               | parts per million  |
| PVP               | Private Veterinary Practitioner                              |
| RBA               | Relative Bioavailability                                     |
| RVL               | Regional Veterinary Laboratory                               |

|       |   |
|-------|---|
| SGV   | Soil Guideline Value                    |
| SSL   | Soil Screening Level                    |
| TCC   | Tipperary County Council                |
| THM   | Total Heavy Metals                      |
| TMF   | Tailings Management Facility            |
| TNRCC | Tipperary (North Riding) County Council |
| µg    | microgram                               |
| µm    | micrometre                              |
| µmol  | micromole                               |
| WG    | Working Sub-Group                       |

## GLOSSARY OF TERMS

**Bioavailability:** the proportion of a substance which is absorbed into the bloodstream and is biologically active

**Geochemical:** relating to the chemical composition of the earth and its rocks and minerals

**Watercourse:** a natural or artificial channel through which water flows i.e. river, stream, open drain

**1 ppb** = 1 µg/kg

**1 ppm** = 1 mg/kg

**mg/kg<sub>DW</sub>** = milligrams per kilogram reported on a dry weight basis where the moisture content has been measured and the concentration calculated is based on the percent solids present

**µg/L** = microgram per Litre

## EXECUTIVE SUMMARY

The Silvermines area has a natural geological occurrence of lead that has been released in to the environment over time both by natural processes and a long history of mining spanning over a thousand years. Although the last mine closed in 1993, years of mining activity left a legacy of open-pits, mine shafts, large waste dumps, tailings and derelict structures, much of which has now been remediated.

In 1999, following a lead poisoning incident in cattle in the Silvermines area, an Inter-Agency Group (IAG) was established composed of different public agencies, to examine the risk to public health, animal health and the environment. This group, chaired by what was then the Department of Agriculture, Food and Rural Development (DAFRD), made 39 recommendations in their report of June 2000 in relation to human and animal health, food safety, soils, environment and rehabilitation of mining works in the Silvermines area. By August 2002 all recommendations had been implemented in full except for three which required a programme of works for the specific remediation of various mining-related sites to be prepared and implemented. This was subsequently done with the first and second phases of rehabilitation works completed in 2009 and 2011, respectively. The third and final phase, to construct a mine waste management facility, remains to be completed.

In early 2017, two dairy cows died from lead poisoning on a farm in the Silvermines area of County Tipperary. Bulk tank milk from this herd was found to contain lead above the maximum level (ML) permitted in milk (0.02 mg/kg) resulting in a restriction on milk supply to safeguard the food-chain. Two further dairy herds in the Silvermines area with lead levels in milk above the ML were also identified and restricted at that time. Follow-up investigations undertaken in all three herds to establish the source of the lead and the pathway of exposure supported a working hypothesis of an environmental source to which cattle had been exposed by winter feeding on 2016-17 ensiled grass that had been contaminated with lead-enriched soil and/or river sediments. These investigations highlighted a specific challenge with regard to milk production on naturally lead-enriched soils (largely reflecting a fifty-fold reduction in the ML for lead in milk, from 1 mg/kg to 0.02 mg/kg, since the previous IAG report in 2000) and also served as a prompt to raise and maintain awareness of the necessity for continued active management in this environment. This incident led to the activation once again of the protocol for collaboration between those public agencies that are responsible for dealing with issues relating to public health, animal health and the environment. An Inter-Agency Group (IAG) chaired by the Department of Agriculture, Food and the Marine (DAFM) was established to review active management measures taken in the Silvermines area and to present its report to the head of each of the government departments and agencies involved. The agencies which participated in the IAG were:

- Department of Agriculture, Food and the Marine (DAFM)
- Department of Communications, Climate Action and Environment (DCCAE)
- Environmental Protection Agency (EPA)

- Food Safety Authority of Ireland (FSAI)
- Health Services Executive (HSE)
- Teagasc
- Tipperary County Council (TCC)

The IAG first met on 10 May 2017 and on five further occasions. Three working sub-groups (WGs) were established by the IAG to consider active management measures with a specific focus on dairy production. In accordance with the terms of reference each WG was assigned one of three key areas to address, namely monitoring, mitigation and communication, all components of an effective risk analysis framework. Responsibility for work on particular components of the investigation within the WGs was assigned, by the IAG, to the relevant government department or agency.

The agreed terms of reference of the IAG were as follows:

- Review the findings and recommendations of previous inter-agency and expert groups convened during the 1999-2004 period, in the light of findings from the current investigation.
- Revise and update the monitoring measures recommended in 1999-2004, with a specific focus on dairy herds and criteria for deciding which herds are to be monitored.
- Revise and update the “active management” measures recommended in 1999-2004 with a specific focus on grassland management.
- Advise on dissemination of information to farming families and the wider local community.

The IAG believes that the Silvermines area is a safe place in which to grow up, live, work and produce food. However it is important that farmers, the local community and relevant agencies continue to implement active management measures on an on-going basis. The overall recommendations of the IAG (and those considered to be responsible for the implementation of each in parentheses) are listed below, with the detailed work informing these recommendations presented in the succeeding chapters. This report broadly recommends the same active management measures as recommended by the IAG in 2000, reflecting the fact that the risk has not substantively changed but the recommended measures have been updated and enhanced to reflect the latest regulatory standards and scientific risk assessment information.



The recommendations are:

### ***Risk Assessment***

1. The area of interest in respect of monitoring activities should be based on the 1999 study area but extended by approximately 1km to the east of Silvermines village, informed by currently available information on the levels of total heavy metals in soil.
2. Group water schemes should be subject to on-going monitoring by the relevant supervisory authority (TCC or Irish Water) to establish that lead levels comply with statutory limits; households supplied from private sources should follow advice on sampling and testing of drinking water to establish that lead levels meet statutory limits.  
[Information leaflets prepared by the HSE in consultation with Irish Water and the EPA]
3. A targeted programme of sampling and testing should be implemented to monitor lead levels in milk.  
[This is primarily the responsibility of dairy processors collecting milk from the Silvermines area but with oversight and verification by DAFM]
4. The programme of environmental (biological and physico-chemical) and geotechnical monitoring of the Gortmore Tailings Management Facility and other mining-related sites and local river systems should be continued.  
[DCCA; EPA]
5. A targeted programme of sampling and testing should be implemented to monitor lead levels in tissues of other grazing animals at slaughter to complement the existing monitoring programme in cattle.  
[DAFM]
6. Suspected cases of lead poisoning in animals should be investigated:
  - Farmers and private veterinary practitioners (PVPs) attending farms should submit carcasses or tissues of fallen animals for post-mortem examination or laboratory analysis especially in instances of sudden death [Farmers; PVPs];
  - DAFM should provide laboratory diagnosis and follow-up investigations for suspected cases [DAFM].

### ***Risk Management***

7. Specific measures should be taken in the home and in the locality to protect human health by minimising human exposure to lead.  
[This is the responsibility of the local community – to follow advice and guidance provided by the HSE]

8. Specific measures should be taken at farm level to ensure safe food production and protect animal health and welfare by minimising exposure of animals to lead.  
[This is the responsibility of farmers – to follow advice and guidance provided by Teagasc]
9. Dairy farmers should be assisted in managing risk by being provided with maps of their land holdings showing the distribution of lead and/or total heavy metals in soil and with bespoke advice on soil and grassland management for their holding.  
[DAFM to provide “heat maps” on consent of the farmer to process landholding data; Teagasc to provide advice on request of the farmer]
10. Flagging of bovine animals on the Animal Identification and Movement (AIM) system should be implemented on an individual animal basis (rather than a herd basis) to ensure that offal (liver and kidney) is discarded at slaughter.  
[DAFM]
11. All premises containing equine animals should be registered and equine animals should be identified on the AIM system to ensure that offal (liver and kidney) is discarded at slaughter.  
[Registration of premises is the responsibility of owners of equine animals; enforcement of controls is the responsibility of DAFM]
12. The final phase of rehabilitation of mining-related sites, involving the construction of a Mine Waste Management Facility in the Silvermines area, should be completed.  
[DCCAIE]

### ***Risk Communication***

13. An annual inter-agency meeting with representatives from all relevant agencies should be convened to:
  - Review the risks and monitor on-going implementation of the recommendations of this report and previous reports;
  - Review new evidence with potential impact on existing advice for local residents.  
[Note: *any agency may use the existing protocol to request a meeting outside of this annual schedule to share new knowledge pertaining to risk and/or to avail of the knowledge and expertise in other agencies*];
  - Ensure that the communication procedures are appropriate and on-going including:
    - i. Update of information on the website;
    - ii. Review all leaflets annually and update with any new information or evidence that has arisen since the previous review. Consider their circulation within the local community / farms as required and at a minimum every 3 years.  
[TCC to convene, host and chair this annual meeting]

14. Information and advice aimed at protecting human health should be reviewed annually, updated and distributed to the local community and to local health service providers on a periodic basis. [Note: *For the purposes of communication regarding health, the area of interest should be based on the 1999 study area but extended by approximately 1km to the east of Silvermines village*].  
[The HSE should review, update and distribute this information, including advisory leaflets]
15. Information and advice aimed at ensuring safe food production and protecting animal health and welfare should be reviewed annually, updated and distributed to the local farming community on a periodic basis.  
[Teagasc should review, update and distribute this information, including an advisory leaflet]
16. Information and advice aimed at ensuring and verifying safe food production should be reviewed annually, updated and distributed to food business operators.  
[DAFM should review, update and distribute this information]
17. All advisory information should be proof-read by the National Adult Literacy Agency (NALA) to ensure that it is easily understood by the target audience.  
[Relevant agencies to liaise with NALA]
18. All published reports, advisory leaflets and other relevant information on active management in the Silvermines area should be readily available via a dedicated and curated web-page.  
[TCC to host this web-page and update it as necessary]



## **1.0 INTRODUCTION**

### **1.1 Background**

This is a report of an Inter-Agency Group (IAG) established to review active management measures following an incident of lead poisoning in two dairy cows on a farm in the Silvermines area of County Tipperary in mid-February 2017. Post-mortem examination of these animals at the Department of Agriculture, Food and the Marine's (DAFM) Regional Veterinary Laboratory (RVL) in Limerick confirmed that they had died as a result of lead poisoning. Bulk tank milk from this herd was found to contain lead (Pb) above the maximum level (ML) permitted in milk (0.02 mg/kg) resulting in a restriction on milk supply to safeguard the food-chain. Two further dairy herds in the Silvermines area with lead levels in milk above the ML were also identified and restricted at that time. Follow-up investigations undertaken in all three herds to establish the source of the lead and the pathway of exposure supported a working hypothesis of an environmental source to which cattle had been exposed by winter feeding on 2016-17 ensiled grass that had been contaminated with lead-enriched soil and/or river sediments. These investigations highlighted a specific challenge with regard to milk production on naturally lead-enriched soils (since the previous IAG report in 2000 the ML for lead in milk had seen a fifty-fold reduction from 1 mg/kg to 0.02 mg/kg) and also served as a prompt to raise and maintain awareness of the necessity for active management in this environment.

In 1999 a similar lead poisoning incident in cattle in the Silvermines area led to the activation of a protocol for collaboration between public agencies dealing with issues such as human and animal health and the environment (EPA *et al.*, 1997). On that occasion, an IAG, chaired by what was then the Department of Agriculture, Food and Rural Development (DAFRD), was established and made 39 recommendations in relation to human and animal health, food safety, soils, environment and rehabilitation of mining works in the area (DAFRD, 2000). By August 2002 all recommendations had been implemented in full except for three which required a programme of works for the specific remediation of various mining-related sites to be prepared and implemented. This was subsequently done with the first and second phases of rehabilitation works completed in 2009 and 2011, respectively. The third and final phase, to construct a mine waste management facility, remains to be completed. A subsequent expert group convened by the Environmental Protection Agency (EPA) and established following recommendation 39 of the IAG report recommended various "active management" measures by state agencies and the local community to mitigate any risk to human health, animal health and the environment (EPA, 2004).

### **1.2 The Area**

The Silvermines area lies along the northern flank of the Silvermines Mountain. The geology of the area is dominated by a complex series of structures known as the Silvermines Fault Zone and has a natural geological occurrence of lead which over time has resulted in

enrichment of the environment (e.g. soils) by natural processes. This natural metal-enriched environment has had a long history of mining. The area has been mined for a range of commodities (principally zinc, lead and barytes) since at least the 9<sup>th</sup> century. Although the last mine closed in 1993, years of mining activity has resulted in a substantial legacy of mining-related features across the area including: open-pits, underground workings, shafts, waste dumps, tailings, adits and derelict structures, much of which has now been remediated. There are five main sites of historical mining (Ballygown, Magcobar, Garryard, Gorteenadiha and Shallee) and a Tailings Management Facility (TMF) at Gortmore in the Silvermines area.

### **1.3 The Inter-Agency Group**

As part of the investigation referred to above in spring 2017 DAFM deemed it appropriate to formally activate the IAG protocol and call upon the knowledge and expertise of other state agencies – in public health [Health Services Executive (HSE)]; in food safety - chemical risk assessment [Food Safety Authority of Ireland (FSAI)]; in environmental monitoring and management relating to historic mining activity [Tipperary County Council (TCC), Department of Communications, Climate Action and Environment (DCCAE), Irish Water and the EPA] and in soil science and grassland management (Teagasc).

#### **1.3.1 Structure and Proceedings**

The IAG group comprised representatives of the following government departments and agencies:

- *Department of Agriculture, Food and the Marine (DAFM)*<sup>1</sup>, who also chaired the group
- *Department of Communications, Climate Action and Environment (DCCAE)*
- *Environmental Protection Agency (EPA)*
- *Food Safety Authority of Ireland (FSAI)*
- *Health Services Executive (HSE)*
- *Teagasc*
- *Tipperary County Council (TCC)*

A steering group attended by at least one representative from each of the government departments and agencies involved met on 6 occasions with the first meeting held on 10 May 2017. Initially the IAG considered the report of the Inter-Agency Group published by DAFRD in 2000, the report of an expert group published by the EPA in 2004, information on historic mining activity in the Silvermines area reported by DCCAE and farm investigations performed by DAFM in 2017. Subsequent meetings were held in June, July, September and November 2017 with a final meeting to consider a draft report at the end of March 2018.

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<sup>1</sup> The Centre for Veterinary Epidemiology and Risk Analysis (CVERA), based in University College Dublin and funded by DAFM, provided advice and assistance on geographical information systems and mapping.

Within the IAG three working sub-groups (WGs) were convened to consider monitoring, mitigation and communication strategies to safeguard food safety, public health and animal health and welfare, as follows:

1. Future monitoring to be undertaken in the Silvermines area.
2. Active management measures to be undertaken.
3. Appropriate means of disseminating advice to the farming/local community.

### **1.3.2 Terms of Reference and Objectives**

Terms of reference setting out the main objectives were drawn up by the IAG as follows:

- Review the findings and recommendations of previous inter-agency and expert groups convened during the 1999-2004 period, in the light of findings from the current investigation.
- Revise and update the monitoring measures recommended in 1999-2004, with a specific focus on dairy herds and criteria for deciding which herds are to be monitored.
- Revise and update the “active management” measures recommended in 1999-2004 with a specific focus on grassland management.
- Advise on dissemination of information to farming families and the wider local community.

The IAG agreed that its remit and the focus of the current report should be on active management to reduce the risks from the lead-enriched environment of Silvermines. The IAG was required to report its findings and recommendations to the head of each of the government departments and agencies involved, and to provide input into information leaflets and campaigns on “active management” measures for farming families and other members of the local community.

### **1.4 Relevant legislation considered by the Inter-Agency Group in 2017**

As was done with the previous Inter-Agency and Expert Groups a precautionary approach was adopted when considering guideline values in the absence of statutory levels in the current investigation. The legislation considered by the Inter-Agency Group was as follows:

- Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs;

- Commission Regulation (EC) No 333/2007 of 28 March 2007 laying down the methods of sampling and analysis for the official control of the levels of lead, cadmium, mercury, inorganic tin, 3-MCPD and benzo(a)pyrene in foodstuffs;
- Directive 2002/32/EC of the European Parliament and of the Council of 7 May 2002 on undesirable substances in animal feed;
- Drinking Water Directive – Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption;
- European Communities (Food and Feed Hygiene) Regulations, 2009 (S.I. No. 432 of 2009);
- European Union (Drinking Water) Regulations, 2014 (S.I. No. 122 of 2014);
- Sewage Sludge Directive - Council Directive of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture (86/278/EEC);
- Waste Management (Use of Sewage Sludge in Agriculture) Regulations, 1998 (S.I. No. 148/1998);
- Water Framework Directive – Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000, establishing a framework for Community action in the field of water policy.



## **2.0 REVIEW OF INTER-AGENCY AND EXPERT GROUP REPORTS**

### **2.1 Inter-Agency Report 2000**

In 1999 a comprehensive investigation was carried out following the death of three cattle from lead poisoning in the Silvermines area. The report of the IAG in June 2000 detailed 39 recommendations across a broad range of issues in the areas of human and animal health, food safety, soil, herbage, fodder and drinking water (animals), local environment and mine workings. A number of these recommendations related to the implementation of monitoring programmes, some of which were on a once-off basis. These monitoring recommendations included blood lead surveillance in children, internal and external environmental sampling in Silvermines village, blood sampling in animals, fruit and vegetable sampling, milk sampling of dairy herds, tissue sampling of slaughtered animals, biological and physico-chemical monitoring of watercourses and dust monitoring. Details of all 39 recommendations including their implementation and progress are listed in appendix A. Although a number of immediate actions were recommended the IAG outlined an effective identification and management programme of risks in the longer term that would require committed cooperation of all concerned and concluded that provided these precautions were taken that the Silvermines area was a safe place in which to grow up, live and work.

The following guideline and legislative values were used by the various government departments and agencies involved in the 1999 investigation:

- Lead in drinking water intended for human consumption – statutory value of 0.05 mg/L in S.I. No. 81 of 1988 and Council Directive 80/778/EEC.
- Lead in human foodstuffs - statutory values of 2 mg/kg for vegetables, meat, liver and kidney and 1 mg/kg for milk and milk products in S.I. No. 44 of 1972.
- Lead in soil – value of 2,000 mg/kg as the guideline for active management of the environment to protect adults and children. Value of 1,000 mg/kg as a threshold below which toxicity problems are unlikely to occur in grazing animals.
- Lead in air – standard recommended of 250  $\mu\text{g}/\text{m}^2/\text{day}$  as per the German T.A. Luft limits.
- Lead in human blood – CDC acceptable limit of 10  $\mu\text{g}/\text{dl}$ .
- Lead in cattle blood – normal range of 0 – 1.2  $\mu\text{mol}/\text{L}$  (0 - 25 $\mu\text{g}/\text{dl}$ ).

## 2.2 Expert Group Report 2004

An Expert Group was established in June 2001 following recommendation 39 of the IAG report and noted in their report of 2004 that the most effective mechanism for minimising the risk of exposure of animals, humans and the environment was the implementation of a comprehensive “active management” programme. The term “active management”, originally introduced by the IAG report, was subsequently defined by the Expert Group in 12 points (appendix B). The Expert Group issued guidance in relation to human and animal health, sediment disposal, gardening, and soil and mine waste disturbance in relation to lead and other metals. A comprehensive monitoring programme to include the monitoring of human health, animal health and the environment was identified as an important “active management” measure. The Expert Group approved of the monitoring programme implemented at that time and was in agreement with the approach of the IAG to actively manage lead in the Silvermines area by way of blood lead surveillance, internal and external environmental sampling in Silvermines village, animal health monitoring, food safety monitoring, soil, herbage, surface water and stream sediment sampling, biological and physico-chemical monitoring of watercourses and dust monitoring. All recommendations of the Expert Group including monitoring programmes and their implementation and progress are listed in appendix B.

The Expert Group for Silvermines undertook a review of the legislative and guideline values contained in the IAG report of 2000 and were in agreement with the values established for lead in drinking water, human foodstuffs, air, human and cattle blood. Regarding soil and sediment the following guideline values were recommended:

- Lead in soil – value of 1,000 mg/kg<sub>DW</sub> as the guideline for active management of the environment to protect human health. Value of 1,000 mg/kg<sub>DW</sub> as a threshold below which toxicity problems are unlikely to occur in grazing animals.
- Lead in sediment - value of 1,000 mg/kg<sub>DW</sub> for the protection of animal health.
- Lead in human foodstuffs – maximum levels listed in 466/2001/EC (EC, 2001).

## **3.0 RISK ASSESSMENT**

### **3.1 Scope and Terms of Reference**

The objective of the Working Sub-Group (WG) on monitoring was to review the programme of monitoring of lead levels in different foods, animal tissues and the environment in the Silvermines area while considering the findings and recommendations of previous inter-agency and expert groups with a view to recommending revisions required to existing monitoring programmes, if necessary. The WG also undertook to review other issues of relevance, e.g. more recent advances in scientific risk assessment of lead.

### **3.2 Defining the Area of Interest**

In the IAG report of 2000 the geographical boundary of the study area was delineated using both results of a geochemical survey undertaken by Mogul of Ireland Ltd. in 1963 to determine total heavy metals (THM) in soil combined with farm boundaries and district electoral divisions (DEDs). The study area was well defined on several maps and covered an area of approximately 23 square kilometres embracing 90 farms, the Gortmore Tailings Management Facility (GTMF), the tailings at Shallee, lagoons and settlement pond at Garryard, mine openings and mine buildings near Silvermines village.

To define the area of interest for the 2017 investigation, the IAG have considered three separate distribution maps – the distribution of total heavy metals in soil across the Silvermines area (Mogul, 1963; Map 1); the distribution of lead in soil across the Silvermines area (Teagasc, 2000; Map 2) and the distribution of lead in soil in Sragh and neighbouring townlands (Rio Finex, 1964; Map 3). The combination of these distribution patterns reveals that the boundaries of the 1999 IAG study area are characterised by low lead in soil values, with exception of the eastern boundary in the vicinity of Silvermines village. Therefore rather than redefine the 1999 study area, the IAG has agreed to use it with one recommendation, that monitoring and active management measures are extended to include an area of approximately 1km around and to the east of Silvermines village.

### **3.3 Review of Current Monitoring Programmes**

#### **3.3.1 Environmental Monitoring**

Since 2013, Exploration and Mining Division (EMD) of the Department of Communications, Climate Action and Environment (DCCAE) have engaged CDM Smith Ireland Ltd. to undertake a programme of environmental and geotechnical monitoring at various Silvermines sites. This is to ensure that all remediation works undertaken between 2008 and 2011 remain fit-for-purpose and to highlight any potential hazards that may have arisen over time. Environmental monitoring commenced in early 2013 and comprises surface water, groundwater, soil and vegetation sampling and analysis. CDM Smith (2013) also reviewed

the results of historical (2004-2012) dust monitoring undertaken by TNRCC and the EPA at the Gortmore TMF to determine whether future dust monitoring was necessary. The CDM study concluded that no further dust monitoring was required given that:

1. The data indicated a consistent downward trend in metal concentrations in deposited dust;
2. There had been a significant reduction in exceedances of the TA Luft air quality limits in recent years;
3. The risk of dust blows from the GTMF had been minimised through the capping of the TMF where tailings were exposed and the development of a vigorous grass sward on the GTMF surface.

A programme of geotechnical monitoring and hazard appraisal at remediated sites, which commenced in 2013, is undertaken by GWP Consultants LLP on behalf of CDM Smith and involves:

- Inspection of the GTMF and associated wetlands;
- Checking the condition of security fencing around shafts, open pits, ponds, etc.;
- Examination of drains to ensure that they remain free-draining;
- Checking the stability of surface subsidence zones at Gorteenadiha in the initial years;
- Inspection of the vegetated surface of the GTMF to ensure there is no die back of vegetation;
- General walk over of the mine areas to identify any other potential risks and hazards.

Environmental monitoring data and an interpretation of the results are available at <https://www.dccae.gov.ie/en-ie/natural-resources/topics/Minerals-Exploration-Mining/historic-mine-sites/silvermines-projects/Pages/Environmental-Monitoring-at-Silvermines.aspx>

### **3.3.1.1 Surface Water, Ground Water and Drinking Water**

Since 2013 physico-chemical monitoring of surface and ground water has been undertaken biannually (usually March and August) in the Silvermines area during high-and low-flow conditions by CDM Smith Ireland Ltd. Two groundwater monitoring wells, sited respectively up-gradient and down-gradient of the Gortmore TMF are also sampled. Two main types of surface water body are sampled:

- Rivers and streams
- Mine discharges (e.g. shaft and adit discharges, artificial drainage channels, wetland discharges).

In the 2013 to 2015 period, between 31 and 34 surface water sites were sampled (some sites periodically run dry). Water samples were originally analysed for a wide range of parameters,

however, following a detailed review of the surface and ground water monitoring data in 2016, the number of laboratory parameters analysed was significantly reduced. The number of sampling sites was also reduced to some 30 locations (See Map 4).

Recent results of sampling and analysis of ground and surface water, carried out in May 2017, are available (DCCAE, 2017). In summary, lead levels at both ground water sites in the vicinity of the Gortmore TMF were within human health criteria (10 µg/L) as set out in European Union (Drinking Water) Regulations, 2014. With regard to surface water analysed for lead the following was recorded:

- Human health assessment criteria were exceeded in the Shallee mining area at SW1-Shal (stream, 158 µg/L), SW6-Shal (Field Shaft discharge, 248 µg/L) and SW9-Shal (stream, 190 µg/L), DS-Shal (Yellow Bridge River, 55.5 µg/L) and down-stream of the Gorteenadiha mining site (Yellow Bridge River, 12.6 µg/L);
- Livestock assessment criteria<sup>2</sup> (100 µg/L) were exceeded at a small number of sites e.g. Shallee mining area at SW1-Shal, SW6-Shal and SW9-Shal.

A comprehensive national water monitoring programme is designed and managed by the EPA (EPA, 2006) in accordance with the EU Water Framework Directive (EC, 2000). Routine physico-chemical monitoring is carried out by the EPA at five locations along the Kilmastulla and Yellow rivers five times per year. Sampling of the Kilmastulla river is carried out 1) upstream of the Yellow river confluence, 2) at Cranna bridge and 3) at Cool bridge. Sampling of the Yellow river is carried out 1) upstream of the Yellow Bridge and Garryard streams and 2) downstream of the Yellow Bridge and Garryard streams. Biological monitoring is also carried out on the Kilmastulla river at Cranna and Cool bridge and on the Yellow river downstream of the Yellow Bridge and Garryard streams once every three years.

Results of sampling and analysis for 2016 and 2017 were assessed for lead against human health criteria (10 µg/L) and the following was recorded:

- Human health assessment criteria were exceeded on four sampling occasions in 2016 on the Yellow river upstream and downstream of the Yellow Bridge and Garryard streams with a range of 27–45 µg/L and 28–100 µg/L, respectively;
- In 2017 human health assessment criteria were exceeded on all sampling occasions on the Yellow river upstream and downstream of the Yellow Bridge and Garryard streams with a range of 15-63 µg/L and 48–100 µg/L, respectively and on one sampling occasion on the Kilmastulla river at Cranna bridge in 2017 (16 µg/L).

Drinking water supply is largely public supply fed from the Nenagh Regional Water Supply Scheme. The public water supply is subject to continuous monitoring by Irish Water. There are two Group Water Supply Schemes in the original study area; Shallee which is monitored

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<sup>2</sup> Livestock assessment criteria are based on The US National Academy of Sciences (1972) recommendation of a limit of 100 µg/l for lead in drinking water for livestock.

by Tipperary County Council and Castlecranna water supply which currently is not monitored by either Irish Water or Tipperary County Council. There are a number of private wells in the area, which fall under the responsibility of the private households or farms on which they are located.

At the time of the 2000 IAG report the statutory limit for lead in water was 50 µg/L (European Communities (Quality of Water Intended for Human Consumption) Regulations, 1988). The Drinking Water Directive (EC, 1998) reduced the parametric value for lead in water from 50 µg/L to 25 µg/L in 2004 and further reduced it to 10 µg/L in 2013. Current indications suggest that a further reduction to 5 µg/l is under consideration as the European Commission are currently reviewing the Drinking Water Directive (EC, 2018).

### **3.3.1.2 Vegetation and Soil**

Chemical analysis of vegetation and soil has been undertaken on the remediated section of the Gortmore TMF since 2013 to assess the condition of the grass sward (established in late 2008) and to identify any toxic element uptake in soils and herbage. The vegetation monitoring originally comprised a general walk-over survey of the Gortmore TMF surface to identify any areas of poor growth and biannual sampling of vegetation at twenty re-visitable 1 m<sup>2</sup> quadrant sites. Shallow soil samples (0 - 10 cm depth) were collected from the same vegetation quadrants during the summer period only. All samples were analysed for a wide range of metals.

The results obtained from the vegetation and soil monitoring at the Gortmore TMF between 2013 and 2015 indicated that sampling on a yearly basis was not required. No vegetation sample analyses have exceeded the maximum content stipulated in European legislation (EC, 2002). Regarding soil, one sample (58 mg/kg) in 2015 exceeded the maximum value for lead<sup>3</sup> of 50 mg/kg stipulated in the Waste Management (Use of Sewage Sludge in Agriculture) Regulations, 1998 where sewage sludge might be applied. Vegetation and soil sampling at the Gortmore TMF currently takes place every three years, with the next round of monitoring scheduled to take place in 2018. Hazard appraisal at remediated sites is undertaken on an annual basis.

As part of the current investigation targeted sampling of soil on one or more of the farms in the Silvermines area where milk samples showed lead levels above the maximum level were sampled by TCC. Soil lead levels of between 11,000 ppm and 15,000 ppm were recorded from low-lying fields along the Kilmastulla river. These results were similar to the levels recorded in soil geochemistry surveys of the area by an exploration company (Rio Finex) in the 1960s, but higher than those measured during the investigation of the IAG in 1999-2000, possibly due to a different methodology and location of sampling site.

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<sup>3</sup> Where the pH of the soil is consistently higher than 7, the values set may be exceeded by not more than 50%, provided that there is no resulting hazard to human health, the environment or, in particular, ground water.

To support the IAG's investigation into elevated lead values in milk at a number of farms in the Silvermines area, EMD further engaged CDM Smith to carry out a programme of soil and stream sediment sampling and analysis. A portable X-ray fluorescence instrument was utilised to investigate the elemental composition of soil at more than 230 sample sites in some 30 fields frequented by dairy cattle. X-ray fluorescence is a non-destructive analytical technique that can be used to rapidly determine semi-quantitative concentrations of metals (e.g. Pb, Zn, etc.) in soils. In addition, over 60 soil samples were collected from fields and analysed for a full suite of metals. All soil geochemistry data was presented to the respective farmers, including maps showing areas with elevated lead in soils that require careful future farm management practices.

A total of 30 stream sediment samples were collected from the Kilmastulla and Garryclogher rivers, and the Silvermines and Yellow Bridge streams. The lead content of stream sediments ranged between 110 ppm and 17,150 ppm, with the most elevated values being recorded for the Silvermines and Yellow Bridge streams.

In addition to the programme of soil and stream sediment analysis, metal speciation and bioavailability studies on soil and stream sediments collected from one area of the Silvermines region have also been undertaken at the University of Colorado by CDM Smith. Electron microprobe analysis of the soil and stream sediment samples indicated that cerussite ( $\text{PbCO}_3$ ) is the most dominant lead species present, with particle sizes ranging between 1 and 100  $\mu\text{m}$ . Other lead phases identified were lead-bearing iron and manganese oxyhydroxides ( $\text{FeOOH}$ ,  $\text{MnOOH}$ ) and lead phosphate. No particles of lead sulphide (galena) or lead sulphide partially weathered to cerussite were observed. These observations are consistent with natural derivation of the lead minerals from a highly oxidized zone similar to that known at the Ballygown mineralised area, rather than from recent mining of sulphide minerals, or derivation from spoil heaps containing sulphide minerals.

An in-vitro bioavailability test that simulates the digestion of soil in the human gut was completed. The tests were performed on the <250  $\mu\text{m}$  particle size portion of soil and stream sediment samples that had been collected for electron microprobe work. Relative bioavailability (RBA) values ranged between 60 and 67%.

### **3.3.2 Food Monitoring**

There are 25 dairy farms, 109 cattle farms and 6 beekeepers registered in the study area. At the time of the 2000 IAG report the statutory limit, for lead in fruit, vegetables, meat, liver and kidney, was 2 mg/kg and 1 mg/kg for milk and milk products [Health (Arsenic and Lead in Food) Regulations, 1972]. Commission Regulation (EC) No 1881/2006 sets current maximum levels for certain contaminants in foodstuffs. The maximum levels for lead in foodstuffs are given in appendix C.



Monitoring for lead in muscle of cattle, sheep, goats, pigs, poultry, farmed and wild game, milk and honey is implemented at a national level as part of the wider National Residue Control Plan (NRCP).

### **3.3.2.1 Meat and Offal**

Bovine animals from the Silvermines study area are “flagged” on the DAFM Animal Identification and Movement (AIM) system which ensures that when these animals are presented for slaughter at abattoirs their offal (liver and kidney) is discarded.

Up until 2014, samples of muscle, kidney and liver were collected from each bovine animal that was flagged as coming from the Silvermines area when presented for slaughter. Analysis of liver and kidney samples for lead was discontinued and only muscle was tested from 2012 onwards. From 2014 sampling has been carried out on a subset of herds, which were selected based on previous positive samples.

A review by the monitoring sub group of these monitoring activities indicated some gaps in coverage and identified a subgroup of herds that were over-represented, as herds were only sampled if they presented cattle directly for slaughter.

Most animals were flagged on a herd basis such that if they moved to a different herd outside the study area, they were no longer flagged and were not sampled at slaughter. A gap in the notification system for animals slaughtered in Local Authority supervised premises was also identified and has been rectified.

This mechanism for flagging cattle at slaughter for sampling (and discard of offals) would be enhanced by flagging cattle from the Silvermines area on the AIM system on an individual animal basis rather than on a herd basis.

### **3.3.2.2 Milk**

Until Feb 2017, monitoring of milk in the area for lead was implemented as part of the NRCP. Following the recent events, an enhanced monitoring programme, including an industry self-monitoring programme, capturing all farms present in the study area has been implemented.

### **3.3.2.3 Honey and Horticultural Produce**

There are six beekeepers located in the Silvermines area that are registered with DAFM – these are hobbyists maintaining small numbers of hives and producing relatively small amounts of honey for sale. Honey samples were taken in 2017 as part of the NRCP for heavy metal analysis and found to be compliant with legislative maximum limits; a number of these producers will be sampled each year for the foreseeable future as part of the NRCP. Currently



there are no registered fruit and vegetable producers in the area and there is no specific monitoring programme of horticultural produce in place in the Silvermines area. If a commercial horticultural enterprise was to start up in the area, it would be required to implement risk assessment measures as part of its food safety management plan and would then be subject to registration and oversight by DAFM. Only historical data on metal concentrations in fruit and vegetables grown by residents in the Silvermines area is available (1999-2003). It is clear from the data that the majority (88% of the samples) of the fruits and vegetables sampled and tested at that time had lead levels which exceed the maximum levels that now apply in respect of those particular foods (and worth noting that those MLs, like that for milk, have been substantially revised downwards in the intervening years). It is also noteworthy that households were advised at that time not to consume home-grown lettuce because some samples greatly exceeded the statutory levels then in place.

#### **3.3.2.4 Other Food-Producing Animals**

Although horses are not typically considered as food-producing animals in Ireland, they are occasionally slaughtered for human consumption (primarily for export). Horses are currently slaughtered at two premises, both of which are under the supervision of DAFM. As horses grazing in the Silvermines area are also likely to accumulate lead in liver and kidneys, the IAG recommends invoking the precautionary principle as a basis for identifying horses from the area to ensure that offals are excluded from the food-chain if and when any of these horses are presented for slaughter. Note that although there is currently no market for these offals from horses such that they are being discarded, a more proactive approach is indicated. Tissue samples (muscle, liver and kidney) will also be collected from these animals at slaughter and these will be assayed for lead to establish an evidence base for any further action. The same approach is indicated for small ruminants.

#### **3.3.3 Animal Health Monitoring**

Suspect cases of lead poisoning are investigated as they arise on an on-going basis and herdowners are encouraged to notify the RVL of fallen animals which are suspected to have died from lead poisoning.

#### **3.3.4 Hay, Silage and Grass Monitoring**

Directive 2002/32/EC (EC, 2002) sets maximum levels for undesirable substances in animal feed. The maximum level for lead in forage which includes products intended for animal feed such as hay, silage, fresh grass, is 30 mg/kg relative to a feed with a moisture content of 12%. In the 2000 IAG report it was concluded that hay, silage and herbage posed no obvious threat to animals with regard to lead. However, it was recommended that animals should not be allowed to ingest herbage contaminated by soil as herbage lead is known to arise from the physical contamination of the plant surface by soil.

In the initial stages of the current investigation herbage and feed samples on one or more of the farms in the Silvermines area where milk samples showed lead levels above the maximum level were sampled by DAFM and TCC. In the index farm lead analysis in silage and grass samples, identified as originating from low-lying fields along the Kilmastulla river and adjacent to the former Magcohar open pit barytes mine, exceeded the maximum content stipulated in European legislation (EC, 2002).

Chemical analysis of vegetation on the GTMF is presently carried out triennially as part of the monitoring programme implemented by DCCAE. However, there is no systematic monitoring of hay, silage or grass in the greater Silvermines area. Given the inter- and intra-field variability of lead, and the mechanics of silage collection and storage, a consistent approach to produce representative samples to reliably determine heavy metal concentration in silage would be difficult to implement. The IAG considers that this issue is best addressed via best grassland management practice and best feeding practice.

### 3.4 Discussion

Recent scientific evaluations of health hazards associated with lead exposure have generally led to a reduction of guidance values.

In 2010, the European Food Safety Authority's (EFSA) Scientific Panel on Contaminants in the Food Chain concluded that the provisional tolerable weekly intake (PTWI) of 25 µg/kg body weight set by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) in 1986 and endorsed by the European Commission's Scientific Committee for Food (SCF) in 1990 was no longer appropriate as there was no evidence for a threshold for adverse health effects. This conclusion was in agreement with that of JECFA (2010). As an alternative approach EFSA published an opinion on the risks to human health related to the presence of lead in foodstuffs including a set of BMDLs<sup>4</sup> (Benchmark Dose Levels) on three key health effects of lead in adults (renal and cardiovascular toxicity) and children (neurodevelopmental effects). The respective BMDLs derived from blood lead levels (BLLs) in µg/L (corresponding dietary intake values in µg/kg bw per day) were: developmental neurotoxicity BMDL<sub>01</sub>, 12 (0.50); effects on systolic blood pressure BMDL<sub>01</sub>, 36 (1.50); effects on prevalence of chronic kidney disease BMDL<sub>10</sub>, 15 (0.63). Food represents the major source of exposure to lead for the general population in the EU, however, a 2016 FSAI study found that the risk from dietary exposure to lead was lower in the Irish population than in the European population as a whole (EFSA, 2010; FSAI, 2016). Following the opinion of EFSA's scientific panel in 2010 and in order to further reduce the dietary exposure to lead in food, in 2015 the European Commission lowered existing maximum levels (infant formula, certain

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<sup>4</sup> The Benchmark Dose Level refers to the lead concentrations in blood (or tibia bone) associated with a specified response. The BMDL is based on a mathematical model being fitted to experimental data within the observable range and estimates the dose that causes a low but measurable response (the benchmark response BMR) typically chosen at a 5 or 10 % incidence above the control. The BMD lower limit (BMDL) refers to the corresponding lower limits of a one-sided 95 % confidence interval on the BMD. Using the lower-bound takes into account the uncertainty inherent in a given study, and assures (with 95 % confidence) that the chosen BMR is not exceeded.

fruit and vegetables) and set additional maximum levels for lead in relevant commodities such as honey.

In 2012 the U.S. Centers for Disease Control and Prevention (CDC) lowered the acceptable threshold for blood lead concentration in children from 10 µg/dl to a reference value of 5 µg/dl following recommendations of the CDC's Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) as new findings suggested that adverse health effects occurred at BLLs <10 µg/dl (ACCLPP, 2012). As adverse health effects were seen below the old reference level of 10 µg/dl, the committee decided that population data on lead levels should be used to define the new value of 5 µg/dl which was based on the 97.5<sup>th</sup> percentile of the BLL distribution among children 1–5 years old in the United States using data generated by the National Health and Nutrition Examination Survey (NHANES) (CDC, 2012). This means that the 2.5% of children who have levels above this can be identified as having elevated blood levels which may be associated with lead exposure hazards. The ACCLPP also recommended that this value is re-considered every four years so it could be expected that this level may reduce in the future (ACCLPP, 2012). Existing guidelines regarding medical intervention have not changed i.e. medical treatment recommended when BLLs ≥45 µg/dl (i.e. oral chelation therapy). In addition the World Health Organisation have published a factsheet on lead poisoning and health (WHO, 2017).

Internationally, population lead levels (derived from blood lead testing from a representative sample of the population) are being used as reference values. These are specific to each country as lead levels vary somewhat. As there is no current population data on lead levels in humans in Ireland it means that a similar approach to derive a reference value cannot be employed. There may also be complexities in relation to laboratories abilities to quantify lower levels accurately due to limitations of detection methods (Caldwell *et al.*, 2017). Consideration of these technical issues should occur if blood lead sampling is undertaken in the future in an Irish context. In the previous Silvermines study, direct measurement of lead levels in human blood has shown little evidence of exposure with low BLLs measured (Garavan *et al.*, 2008). Efforts should focus instead on appropriate health advice and preventative activities.

There are no uniform European guideline values for lead in soil. In 2014, the UK Department for Environment, Food and Rural Affairs, developed category 4 screening levels (C4SLs) to replace soil guideline values (SGVs) for lead and other elements for residential areas (with and without home-grown produce), allotments, commercial areas and open public spaces to help achieve a more targeted approach to identifying and managing contaminated land in relation to the risk (or possibility) of harm to human health. Agricultural soils were not targeted. C4SLs were developed to provide a higher but simpler test for deciding whether or not land is suitable for use and not contaminated. They describe land with a level of risk that whilst above 'minimal' is still low by combining information on human health toxicology, exposure assessment and normal ambient levels of contaminants in the environment (CL:AIRE, 2014). The previous SGV in the UK for lead in residential soil was 450 mg/kg.

C4SLs for residential soil with and without consumption of home-grown produce are now 210 and 330 mg/kg, respectively. These C4SLs were derived using a soil relative bioavailability of 60%. In the Expert Group report of 2004 a guideline value of lead in soil and sediment of 1,000 mg/kg<sub>DW</sub>, which is three to four times higher than the revised UK values for residential soils, was recommended in the Silvermines area as a level above which active management measures to protect human and animal health should be initiated.

In 1994 the U.S. EPA established a soil screening level (SSL) for lead at 400 ppm (USEPA, 1994). It is based on the potential for increased lead exposure in children playing in lead contaminated soil and is mainly regarded as a guideline to determine whether or not further study is required. However, in 2014, the U.S. EPA convened a technical review workgroup to make recommendations regarding gardening and reducing exposure to lead-contaminated soils as data available when the SSL was established did not adequately account for consumption of home-grown produce (USEPA, 2014). Although insufficient data did not allow for quantitative, risk-based recommendations, the review showed that exposures associated with gardening, both as an activity and through the consumption of home-grown produce could result in greater exposure than previously considered. This technical review workgroup concluded the following:

- *Soil lead concentration below 100 ppm:* Low risk with no specific remedial action needed. Recommended that 100 ppm be used as the low end of the range of soil lead concentrations to initiate best management practices to mitigate exposure.
- *Soil lead concentration >100 – 400 ppm:* Potential risk, therefore reasonable steps to mitigate exposure as children would not only be exposed through playing and from direct soil ingestion or ingestion of soil as house dust but also through the consumption of lead in and on the home-grown produce.
- *Soil lead concentration 400 – 1200 ppm:* Potential risk with specific action needed.
- *Soil lead concentration >1200 ppm:* High risk with specific action needed.

However, the U.S. EPA has different soil screening levels for clean-up of “Superfund” or contaminated sites which includes mining sites and sets ranges for residential (approx. 64 – 400 mg/kg) and industrial soil (270 – 800 mg/kg) based on the form of lead but does not set values for soils for agricultural use.

In 2004 the U.S. Bureau of Land Management (BLM) developed risk management criteria (RMCs) for human health and wildlife for metals at BLM mining sites using available toxicity data and U.S. EPA exposure assumptions (Ford, 2004). RMCs for lead in soil of 244 and 203 mg/kg for cattle and sheep, respectively, were calculated and represent a concentration below which these animals are not expected to experience adverse toxic

effects; however exceedances might require some form of management / intervention and be interpreted as follows:

- less than criteria: low risk
- 1 – 10 times the criteria: moderate risk
- 10 – 100 times the criteria: high risk
- >100 times the criteria: extremely high risk

In 1999 Canada established lead soil quality guidelines of 70 mg/kg<sub>DW</sub> and 140 mg/kg<sub>DW</sub> in agricultural and residential / parkland soil, respectively based on a protocol using scientific information (CCME, 1999). Prior to this many soil criteria were based on professional judgement however the development of this protocol, which was subsequently updated in 2006, ensured the revised guidelines were based on scientific evidence (CCME, 2006). Recently, it has been reported that this guideline was up for review in 2013 based upon the findings of the EFSA 2010 opinion regarding lead in food (CL:AIRE, 2014).

It is clear from this discussion that, not only are there different approaches to establishing guidance values for lead in soil, but there are also variations in the recommended guideline values themselves. Due consideration needs to be given to other factors which determine the likelihood of human and animal exposure to lead such as the bioavailability of metal species, its uptake by plants versus surface contamination and the physiological status of an animal. The availability of lead for uptake by plants from soil is determined by the complexities of different soil properties (Rieuwert, *et al.*, 1998). Lead uptake by plants occurs mainly through the roots where it primarily accumulates and although it has been shown to transport to the shoots it is generally considered that it does not readily translocate to the edible portions of plants (Sharma and Dubey, 2005; Zimdahl, 1976). Animals are exposed to lead either by direct ingestion of soil or by eating grazed or conserved feed crops contaminated by dust or soil (Sharpe and Livesey, 2006).

In the investigation of the 2000 IAG group extensive analysis of soil and sediment was carried out to determine the concentration of lead present, however, bioavailability and metal speciation studies were not done and it is known that total metal concentration is not a reliable indicator of the bioavailable and mobile metal fraction in soils (Rieuwert, *et al.*, 1998). The bioavailability of a metal is influenced directly by the chemical species and the soil characteristics which must be taken into account when assessing the full toxicity of a metal (Ng *et al.*, 2003; Rieuwert, *et al.*, 1998; Morrison *et al.*, 1989). For mining-related sites the need to characterise the potential impact of particle size and speciation on soil bioavailability is recognised (USEPA, 1994).

The RBA values for PbCO<sub>3</sub> in some stream sediments and soil in the study area in this investigation were shown to range between 60 and 67%. Typically RBA values for PbCO<sub>3</sub> would be approx. 80% (Drexler, 1997) but have been shown to be >80% (Casteel *et al.*,

2006). The slightly lower RBA values in the current investigation reflect the presence of other lead-containing species in the samples (particularly iron and manganese oxyhydroxides) which have lower lead bioavailability. The presence in soil of hydrous iron and manganese oxides tends to increase metal adsorption and thus reduce soluble metal contents (Rieuwerts, *et al.*, 1998). The direct applicability of these results to cattle is not known. However, the bioavailability is likely to be relatively high, especially compared to sulphide minerals. The U.S. EPA assume a default RBA value for lead in soil of 60% based on available information in the literature on lead absorption in humans and state that where the measured RBA is higher than 60%, absorption of and hazards from lead may be higher than usually assumed (USEPA, 2007).

In 2001 the maximum level for lead in milk was established at 0.02 mg/kg to protect public health and is the lowest of the MLs for lead, set for infant and follow-on formulas, raw and heat-treated milk, and milk-based products. This represents a fifty-fold reduction in the ML for lead in milk since the previous IAG report in 2000. Although the absorption of lead in children fed contaminated milk and formula has been shown to be as high as 50% (Ziegler *et al.*, 1978), dietary exposure to lead in the Irish population based on data from a total diet study carried out in 2016 has shown dairy products to contribute only 4 and 2% of total lead intake in adults and children in Ireland, respectively (FSAI, 2016).

Lead accumulates in liver and kidney but bone is the primary site of deposition (Sharma, 1982). Although urine and faeces are considered to be important excretory routes it can also be removed from the body through milk (USEPA, 1986). Lactation and pregnancy will result in the mobilisation of bone lead stores (Gupta, 2007). Lead exposure studies in dairy cows have shown no appreciable rise of lead in milk at low levels of lead intake, but a dose-related increase where the lead level in milk was relatively constant up to a blood lead level of 0.2-0.3 mg/kg, increasing sharply at higher blood levels (Oskarsson *et al.*, 1992). Other studies have detected no lead in milk following parturition in previously exposed cattle despite increases in BLLs but the method detection limit was more than twice the EU ML (Galey *et al.*, 1990). The mobilisation of lead into blood could account for the increases in blood lead levels seen following parturition. In a study of BLLs in cattle following accidental lead exposure lactating heifers had the shortest blood lead half-lives suggesting milk as an excretory route, however this could not be demonstrated as milk was not sampled (Rumbeiha *et al.*, 2001).

In conclusion the different approaches for establishing and utilising guidance levels for lead in soil suggest a large degree of uncertainty in how applicable this approach is to the situation that pertains in the Silvermines area. In addition, in 2004, the Expert Group did not consider it appropriate to recommend a blanket adoption of international soil guideline values due to the unique nature of the Silvermines area. The direct measurement of lead levels in animals and food is an appropriate means of monitoring and assessing risk. Historically direct measurement of lead levels in human blood in the Silvermines area has shown little evidence of exposure with low blood lead levels observed in the previous study. Continued or routine



blood lead level monitoring in humans is unlikely to be useful as there is no reason to anticipate a different outcome at this point in time; therefore routine human blood level monitoring is not recommended. Efforts should focus instead on preventative activities and appropriate health advice. The direct measurement of lead in animal tissues and in food has been shown to be a more effective means of assessing emerging risks.

### **3.5 Recommendations**

Based on a review of practices in place, historical and new data/information available, the risk assessment working sub-group recommends the following actions:

1. The area of interest in respect of monitoring activities should be based on the 1999 study area but extended by approximately 1km to the east of Silvermines village, informed by currently available information on the levels of total heavy metals in soil.
2. Group water schemes should be subject to on-going monitoring by the relevant supervisory authority (TCC or Irish Water) to establish that lead levels comply with statutory limits; households supplied from private sources should follow advice on sampling and testing of drinking water to establish that lead levels meet statutory limits. [Information leaflets prepared by the HSE in consultation with Irish Water and the EPA]
3. A targeted programme of sampling and testing should be implemented to monitor lead levels in milk.  
[This is primarily the responsibility of dairy processors collecting milk from the Silvermines area but with oversight and verification by DAFM]
4. The programme of environmental (biological and physicochemical) and geotechnical monitoring of the Gortmore Tailings Management Facility and other mining-related sites and local river systems should be continued.  
[DCCAE; EPA]
5. A targeted programme of sampling and testing should be implemented to monitor lead levels in tissues of other grazing animals at slaughter to complement the existing monitoring programme in cattle.  
[DAFM]
6. Suspected cases of lead poisoning in animals should be investigated:
  - Farmers and private veterinary practitioners (PVPs) attending farms should submit carcasses or tissues of fallen animals for post-mortem examination or laboratory analysis especially in instances of sudden death [Farmers; PVPs];
  - DAFM should provide laboratory diagnosis and follow-up investigations for suspected cases [DAFM].

## **4.0 RISK MANAGEMENT**

### **4.1 Scope and Terms of Reference**

As noted in the Expert Group report of 2004 the term “active management” was originally introduced by the IAG in 2000 and to be effective required the involvement of the local and national public agencies, the local community and local people as individuals and others. The Expert Group considered that a comprehensive active management programme was the most effective mechanism for minimising the risk of exposure and subsequently expanded on this by defining the term in 12 points (appendix B).

In the current IAG the scope of the Working Sub-Group (WG) on mitigation was to review the active management measures undertaken following the previous investigation with a view to updating where necessary. The areas of human and animal health, food safety and the environment were assessed with a particular focus at farm level, on soil and grassland management. Furthermore, with regard to the fifty-fold reduction in the ML for lead in milk since the previous IAG report, the need to exercise much greater care in preventing access of milking cows to lead-contaminated pastures and/or feed was recognised.

In addition to a comprehensive monitoring programme, detailed in the previous chapter, other key strategies to actively manage the risk that lead presents to human and animal health and the environment in any community are education and communication (detailed in the next chapter).

### **4.2 Specific Measures to Protect Human Health**

Because of their behaviour and physiology children are at a higher risk of being adversely affected by exposure to lead than adults. However, pregnant women are also in the higher-risk group. Following the investigation of the previous IAG, an extensive blood lead level screening programme was carried out in adults, pre-school and primary school children from 1999 to 2001 in the Silvermines area. This screening did not reveal high BLLs requiring treatment. A research paper on the child BLL screening showed that the average BLLs across all age groups was lower than 5 µg/dl (Garavan *et al*, 2008). Additionally over the three years of monitoring, the BLLs in this cohort declined. In light of the low levels, downward trend and invasive nature of monitoring, this monitoring programme was discontinued.

Educational campaigns by professional groups such as healthcare providers, agricultural advisors, veterinary professionals, local authority and water services personnel are required to ensure that health and environmental aspects of lead poisoning are understood as well as any recent developments in its prevention and changes to statutory levels. Awareness campaigns and the dissemination of information through leaflets should be targeted to healthcare providers, parents, childcare providers, schools and the wider community. Parents and parents-to-be should be informed of simple steps such as proper nutrition i.e. adequate dietary



intake of calcium, iron and vitamin C; housekeeping measures such as keeping your house clean, and other measures such as hand-washing, cultivation and preparation of locally-grown fruit and vegetables, keeping children away from bare soil, and preventing recreational access to rivers and streams, which should limit lead exposure.

#### **4.3 Specific measures to Ensure Safe Production of Food from Animals and to Protect Animal Health and Welfare**

The fifty-fold reduction in the ML for lead in milk since the previous IAG report in 2000 and the exceedances in early 2017 for lead in bulk milk from farms in the Silvermines area served as a prompt to convene this IAG and commence a monitoring programme in milk by the food business operator (FBO) and DAFM. However, experience of the spring and autumn of 2017 would suggest that these times of the year are likely to be particularly challenging for dairy farms because of the greater likelihood of soil ingestion by animals (due to wet conditions, poaching and bare pastures) and lower levels of milk production, effectively resulting in the concentration of lead in milk. These conditions necessitate particular rigorous requirements in pasture management.

Soil and river sediments are the main source of environmental lead for farm animals. A regime of careful grazing and pasture management can ensure that animals do not have access to herbage that has been heavily contaminated with lead-enriched soil or sediment. Risk reduction measures including the following should be considered:

- Avoid overstocking, overgrazing, out-of-season grazing and poaching of land;
- Rotate grazing of fields to give animal groups some periodic respite on the low lead areas;
- Apply fertiliser based on Teagasc current nutrient advice;
- Roll grass paddocks in spring before turnout;
- Use permanent pastures which helps establish a tight mat and stabilises the soil surface;
- Avoiding cutting grass or ripping soil with low blade settings on mowers / silage cutters;
- Use direct cutting of silage (i.e. no wilting as this can increase the risk of grass contamination during pick up);
- If ground becomes compacted, break the compacted layer after silage has been harvested and roll. Avoid ploughing where possible;
- Avoid soil disturbance;
- Prevent access of all stock to watercourses to avoid disturbing in-situ stream sediments;
- Do not allow dairy cattle to drink water sourced from watercourses;
- Should extraction of water from watercourses be employed for stock (excluding dairy cattle), this should be done using a mechanism which avoids disturbing sediments. Note: lead levels in water greater than 0.05 mg/L may present a risk to livestock.
- Do not dredge watercourses;

- Prevent grazing of pastures subject to flooding as herbage will become coated with sediment; remove animals from affected pastures for 3 to 4 weeks until this coating is cleaned off by wind and rain and grass growth.

Good grazing and pasture management is particularly essential in wet conditions and flooding. In addition implementation of careful farm management practices can be greatly enhanced when equipped with knowledge of the lead status of soils.

Effective active management for the purposes of ensuring food safety requires up-to-date knowledge of permitted concentrations of lead in foodstuffs, the incorporation of these limits into comprehensive monitoring programmes and knowledge of the methods of sampling and analysis of heavy metal residues. DAFM incorporates the regulations on maximum levels in foodstuffs (EC, 2006) and methods of sampling and analysis (EC, 2007) into the NRCP to monitor heavy metal residues in animal products. The discard of livers and kidneys, in which heavy metals such as lead tend to accumulate, was indicated based on historical sampling and analysis and facilitated because of an established identification and traceability system for cattle. A similar system needs to be established for other grazing animals that might end up in the food chain, based initially in the short to medium term on the precautionary principle, but evidence needs to be assembled based on sampling and testing to proceed with or discontinue the exclusion of offals in the longer term.

#### **4.4 Mining-Related Sites**

##### **4.4.1 Background to Silvermines Rehabilitation Project**

Three of the recommendations (no.'s 28, 36 and 37) specified by the June 2000 IAG report were for management and rehabilitation plans to be drawn up and implemented for each historic mine site, the Garryard mine complex and for other sites with elevated lead concentrations in the area which may be identified. In accordance with these recommendations, the then Department of Marine and Natural Resources (DMNR) appointed international mining and environmental consultants Steffan, Robertson and Kirsten (SRK) (UK) Ltd, to undertake the necessary surveys and studies and to prepare conceptual designs for the management and rehabilitation of the Silvermines region (SRK, 2002).

Following the expiry of its mining facility in 1998, the Department engaged extensively with Mogul of Ireland Ltd, who had operated the zinc mining lease up until the 1980s and who were legally obliged, on a once-off basis to remediate lands affected by its working of 'State Minerals'. These lands comprised about 50% of the total site area affected. In late June 2005, the Government agreed that the State would assume responsibility for the rehabilitation of former mine sites at Silvermines, at an estimated cost of €10.6 million over a four-year period. The legislative basis for carrying out the works was enacted in 2006 (Energy (Miscellaneous Provisions) Act 2006).

#### **4.4.2 Remediation Works**

North Tipperary County Council was appointed as the Minister's agent to manage the rehabilitation works at Silvermines, with funding being provided by DCCAE. Golder Associates were contracted to finalise the designs and manage the implementation of the rehabilitation programme as set out in SRK's conceptual plans. In addition to finalising engineering designs, Golder undertook extensive site investigation work and estimated that the total cost of the rehabilitation project was approximately €24M, substantially higher than the initial €10.6M provided for by Government.

At the request of the local community in 2008, conservation works were carried out on five historic mine structures at the Ballygown and Shallee sites, partly funded by the EU.

Subsequently, following extensive local consultation, it was agreed that the TMF at Gortmore would be the first site to be rehabilitated. Capping and other necessary works at the site were largely completed in 2009. A self-sustaining vegetation cover has now been established over the tailings that virtually eliminates the risk of future dust blows from the TMF and at a cost of €6-7M.

A second major phase of rehabilitation works commenced in late Summer 2010 focused on completing safety works at the Ballygown, Magcobar, Garryard, Gorteenadiha and Shallee sites and involved such tasks as making shafts safe, demolishing derelict buildings and structures, fencing off ponds and open pits. This phase of the project was completed in mid-2011.

The third and final phase of rehabilitation works at Silvermines was to construct an engineered facility for the containment of mine wastes from the other sites. Following public consultation and detailed technical assessment, it was proposed that the 'Mine Waste Management Facility' (MWMF) should be constructed in the footprint of the Garryard tailings lagoon. Unfortunately, due to the severity of the economic downturn in 2011 the decision was taken to postpone the MWMF works until such time as sufficient funds were available to execute the full project to completion.

To date, over €11 million has been spent on rehabilitation works at the Silvermines sites. It is provisionally estimated that an additional €10 million plus will be required to finalise the project works.

#### **4.5 Discussion**

The active management measures required in the Silvermines area remain largely unchanged from those that were recommended by the IAG in 2000 and endorsed by the Expert Group in 2004. Minimising exposure to lead-enriched dust, soil and sediment and minimal disturbance of soil and sediments are fundamental principles underpinning many of these active

management measures. The recommendations on risk management in this report re-iterate this but include some additional measures to enhance risk management for food safety purposes at farm level and during primary processing.

Relatively high concentrations of lead are present in soil in certain parts of the study area. Although studies have attempted to find a link between lead levels in soils and exposure to humans the relationship is very complex. Children exposed to lead in mining areas have been shown to have elevated BLLs believed to be caused by the high bioavailability of lead in soil and dust (Gulson *et al.*, 1994). Conversely, other populations in historical mining areas with high lead concentrations in soil and dust samples did not appear to be significantly exposed which was thought to be due to the insoluble form of lead present (Cotter-Howells and Thornton, 1991). In the previous Silvermines study, direct measurement of lead levels in human blood has shown little evidence of exposure with low BLLs measured (Garavan *et al.*, 2008). Nevertheless, steps limiting exposure to lead are an effective way of preventing any potential adverse effects on human and animal health.

Animals are mainly exposed to lead either by direct ingestion of soil or by eating grazed or conserved feed crops contaminated by dust or soil (Sharpe and Livesey, 2006). Grazing animals can ingest large quantities of soil – up to 18% of the dry matter intake in cattle and up to 30% in sheep (Thornton and Abrahams, 1983). Measures to reduce soil ingestion should prevent lead poisoning and excessive levels of lead in animal products (Sharpe and Livesey, 2006). Cattle will also eat soil deliberately, especially if they are deficient in minerals (Underwood and Suttle, 1999).

While regulatory controls, including monitoring of lead levels, have to be implemented for food that is produced for sale, home-grown food for own consumption is not subject to regulation or monitoring. However it is important that these are produced in a way that makes them safe for consumption through actions that minimise exposure to and ingestion of lead-enriched soils and sediments. In the case of backyard poultry, practical steps can be taken to include the addition of clean soil, mulch or other clean cover material to chicken runs (which should be inspected regularly and maintained to prevent chickens coming into contact with the underlying soil) and to use feeders rather than scattering feed on the bare ground.

As regards households that produce their own fruit, vegetables or salad leaves – a review of data on lead levels in these food stuffs from an extensive survey undertaken from 1999-2003, when interpreted in the context of currently applicable MLs, (taken together with the prospecting data from the 1960s that shows elevated levels of heavy metals in soil across the Silvermines area) are the basis for revising the advice that is given to householders. The Expert Group convened by the EPA, which reported in 2004, recommended that “where vegetables are to be grown, clean soil should be imported and spread to a depth of 30cm” when soil lead levels exceeded a soil guideline value (1000 mg/kg) which they had agreed upon as appropriate at that time. A group convened for similar purposes by the U.S. EPA and which reported in 2014 came to broadly the same conclusion, recommending what they refer

to as “soil amendments...up to and including raised beds and containers” again with reference to threshold lead levels in soil (USEPA, 2014). In the absence of exhaustive information on lead levels in soil in all potential gardening spaces and in all the possible varieties of home-grown produce that might be grown (and given the practical limitations to generating such data), the advice to householders in the Silvermines area is that fruit and vegetables should be grown only on imported soil<sup>5</sup> or compost, preferably in containers or raised beds and that these foods should be carefully prepared (washed and peeled, outer leaves removed) to remove all traces of soil before consumption.

With regard to the dredging of sediments from rivers and streams the exact impact is unknown. Golder Associates (2007) suggested that it was likely that this activity reduces the metal loading on the river base but that when it is placed on the bank it most likely makes its way back into the stream during heavy rainfall events, where vegetation has not covered it over. In addition, as highlighted by the Expert Group in 2004, dredging should be minimised as oxidation of dredged material can lead to increased mobility of heavy metals.

Providing a safe water supply is an important strategy for ensuring safe food production and protecting animal health and welfare. On-going environmental monitoring of surface water in the Shallee mining area has demonstrated exceedances above the US National Academy of Sciences (1972) recommendation for lead in drinking water for livestock (100 µg/L). Although the statutory limit for lead in drinking water for humans is 10 µg/L there is no legislative value established for lead in livestock drinking water in the EU. The previous IAG and Expert Group reports did not establish guideline values. In the U.S. the National Academy of Sciences (1972) established a lead upper limit of 0.1 mg/L which was determined as a safe concentration at which the health of animals and their products should be maintained but Soltanpour and Raley (2007) noted that lead is accumulative and problems may begin at a threshold value of 0.05 mg/L. Canadian guidelines also require the livestock drinking water lead concentration to be below 0.1 mg/L (Olkowski, 2009). In more recent years a subcommittee on dairy cattle nutrition at the National Academy of Sciences (2001) published an upper-limit guideline of lead in water for cattle at 0.015 mg/L.

The amount of water consumed by livestock on a daily basis depends on the feed dry matter, weather conditions and type of livestock (milk yield) and could be anywhere between 70 and 140 litres/day for a lactating dairy cow. The amount of soluble lead in surface waters depends upon the pH of the water and the dissolved salt content i.e. it is less soluble in hard water and water at > pH 5.4 (ATSDR, 2007). Although feed can contain considerably larger quantities of lead than water and the major effort in risk management should be focused on feed, water may contribute to the overall burden of dietary lead and it has been noted that lead in water is more efficiently absorbed than lead in food (Olkowski, 2009 and Crichton, 2012).

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<sup>5</sup> Soil should be sourced from outside the study area and contain low lead concentrations.

## 4.6 Recommendations

Based on a review of practices in place, historical and new data/information available, the active management group recommends the following actions:

1. Specific measures should be taken in the home and in the locality to protect human health by minimising human exposure to lead.  
[This is the responsibility of the local community – to follow advice and guidance provided by the HSE]
2. Specific measures should be taken at farm level to ensure safe food production and protect animal health and welfare by minimising exposure of animals to lead.  
[This is the responsibility of farmers – to follow advice and guidance provided by Teagasc]
3. Dairy farmers should be assisted in managing risk by being provided with maps of their land holdings showing the distribution of lead and/or total heavy metals in soil and with bespoke advice on soil and grassland management for their holding.  
[DAFM to provide “heat maps” on consent of the farmer to process landholding data; Teagasc to provide advice on request of the farmer]
4. Flagging of bovine animals on the Animal Identification and Movement (AIM) system should be implemented on an individual animal basis (rather than a herd basis) to ensure that offal (liver and kidney) is discarded at slaughter.  
[DAFM]
5. All premises containing equine animals should be registered and equine animals should be identified on the AIM system to ensure that offal (liver and kidney) is discarded at slaughter.  
[Registration of premises is the responsibility of owners of equine animals; enforcement of controls is the responsibility of DAFM]
6. The final phase of rehabilitation of mining-related sites, the construction of a Mine Waste Management Facility in the Silvermines area, should be completed.  
[DCCAIE]

## **5.0 RISK COMMUNICATION**

### **5.1 Scope and Terms of Reference**

Risk communication is an important tool for disseminating information. The previous Inter-Agency and Expert Groups undertook comprehensive work, covering a broad range of important issues, during their investigations into the presence and influence of lead in the Silvermines area, however, due consideration was not given to a long-term sustainable communication strategy by either group.

In the current IAG the scope of the Working Sub-Group (WG) on communication was to define a process supporting individuals to grow up, live, work and produce food safely in the Silvermines area which ensures that information regarding lead continues to be updated and disseminated in an on-going but low-key and sustained manner. The subgroup discussed a number of key guiding principles to guide the design of a long-term sustained communication strategy and agreed that it should be:

- Proportionate to risk; low-key and sustained;
- Clearly defined in relation to:
  - a) the general target group and specific target groups;
  - b) communication roles and responsibilities of the key organisations including responsibility for updating new staff;
- Be embedded in routine communication structures accepted by local community including healthcare professionals;
- Incorporate a review structure which reviews any new evidence/legislation.

The subgroup discussed four areas in detail:

- Target audience
- Key players
- Key messages
- Communication of messages

### **5.2 Target Audience**

1. All residents in the Silvermines area.
2. All farmers in the Silvermines area.
3. Other food business operators operating in or sourcing food from the Silvermines area.

### **5.3 Key Players**

Professional groups advising local residents:

- Healthcare professionals



- Agricultural advisors and veterinary professionals
- Local authority and water services personnel

#### **5.4 Key Messages**

1. Advice to the general community on measures to be taken in the home and local environment to protect human health.
2. Advice to farming families on farming practices to ensure safe food production and to protect animal health and animal welfare.
3. Advice to food business operators on monitoring and risk management to ensure food safety.

#### **5.5 Discussion**

The incident which occurred in early 2017, prompted the activation of the protocol for inter-agency collaboration both to deal with the specific challenge of milk production (with lower ML for lead in milk) and the more general issue of ensuring that the farming community and the wider local community in the Silvermines area remain aware of the need for continuing active management. Inter-agency collaboration will be required on an on-going basis to ensure effective but low-key, sustained communication on active management to minimise the risk of exposure to lead.

In the Silvermines area lead-enrichment in the environment arises primarily because of the natural geology. However this IAG has concluded that it is safe to grow up, live, work and produce food in this area provided that advice on active management measures is followed. This is the key message to be communicated by the IAG to all stakeholders.

*Advice to the general community on measures to be taken in the home and local environment to protect human health.*

The local community will be provided with information on specific measures that can be taken in the home and locality to protect human health by minimising human exposure to lead. Parents and those who work with/care for children can take some further steps to reduce the exposure of children to potential sources of lead. In addition advice will be provided on safe practices for growing, preparing and eating home-grown produce. Education and information will be provided to all healthcare professionals including an induction sheet for new healthcare staff who will be working in the Silvermines area.

*Advice to farming families on farming practices to ensure safe food production and to protect animal health and animal welfare.*

All farming families, particularly dairy farmers, can safely produce food in the Silvermines area provided practical steps are taken to minimise exposure of food-producing animals to



lead from lead-enriched soils and sediments. An advisory information leaflet will be sent to all farmers in the area to advise on practical measures that can be taken at farm level. Detailed information on soil lead levels in individual holdings will be provided to dairy farmers in the area who consent for their land holding data to be processed by DAFM for this purpose. In addition, Teagasc will provide practical, bespoke advice on soil and grassland management to any dairy farmer that requests this. Information seminars have been hosted by dairy processors to highlight how this risk is being monitored and how it can best be managed.

*Advice to food business operators on monitoring and risk management to ensure food safety*

DAFM will liaise with all food business operators (FBOs) operating in or sourcing food in the Silvermines area. FBOs will be advised of appropriate monitoring and risk management steps that they should take and will be informed about official controls that are being undertaken to ensure the continued safety of food produced from the Silvermines area.

The periodic review, update and dissemination of information needs to be done at least every 3 years but perhaps more frequently if any new information arises but in any event reviewed annually. To ensure clarity and consistency of the message to the community all advice should be rendered in plain English so that it may be easily understood by the target audience. All publicly available information should be easy to access from one source/site which should contain linkages between relevant websites hosted by (and reports published by) the different agencies.

## **5.6 Recommendations**

1. An annual inter-agency meeting with representatives from all relevant agencies should be convened to:
    - Review the risks and monitor on-going implementation of the recommendations of this report and previous reports;
    - Review new evidence with potential impact on existing advice for local residents.  
[Note: any agency may use the existing protocol to request a meeting outside of this annual schedule to share new knowledge pertaining to risk and/or to avail of the knowledge and expertise in other agencies];
    - Ensure that the communication procedures are appropriate and on-going including:
      - i. Update of information on the website;
      - ii. Review all leaflets annually and update with any new information or evidence that has arisen since the previous review. Consider their circulation within the local community / farms as required and at a minimum every 3 years.
- [TCC to convene, host and chair this annual meeting]

2. Information and advice aimed at protecting human health should be reviewed annually, updated and distributed to the local community and to local health service providers on a periodic basis. [Note: *For the purposes of communication regarding health, the area of interest should be based on the 1999 study area but extended by approximately 1km to the east of Silvermines village*].  
[HSE should review, update and distribute this information, including advisory leaflets]
3. Information and advice aimed at ensuring safe food production and protecting animal health and welfare should be reviewed annually, updated and distributed to the local farming community on a periodic basis.  
[Teagasc should review, update and distribute this information, including an advisory leaflet]
4. Information and advice aimed at ensuring and verifying safe food production should be reviewed annually, updated and distributed to food business operators.  
[DAFM should review, update and distribute this information]
5. All advisory information should be proof-read by the National Adult Literacy Agency (NALA) to ensure that it is easily understood by the target audience.  
[Relevant agencies to liaise with NALA]
6. All published reports, advisory leaflets and other relevant information on active management in the Silvermines area should be readily available via a dedicated and curated web-page.  
[TCC to host this web-page and update it as necessary]

## 6.0 CONCLUSIONS AND RECOMMENDATIONS

The IAG concludes that the Silvermines area is a safe place in which to grow up, live, work and produce food, provided that farmers, the local community and relevant agencies continue to implement active management measures on an on-going basis. In order to do this strategies for communication will need to be implemented in a low-key but sustained way in the longer term. This report recommends the same active management measures as recommended by the IAG in 2000, reflecting the fact that the risk has not substantively changed but the recommended measures have been updated and enhanced to reflect the latest regulatory standards and scientific risk assessment information.

This report has focused on the specific challenge of milk production on lead-enriched soils given that the ML for lead in milk has reduced fifty-fold since the previous IAG report in 2000. The IAG emphasises that active management measures will have to be taken on a continuing basis in the Silvermines area because of the natural occurrence of lead in the underlying bedrock and its release into the environment both through natural weathering processes and centuries of mining. The 18 recommendations of the IAG are set out under the principal headings of risk assessment, risk management and risk communication.

The recommendations of the IAG (and those considered to be responsible for the implementation of each in parentheses) are:

### *Risk Assessment*

1. The area of interest in respect of monitoring activities should be based on the 1999 study area but extended by approximately 1km to the east of Silvermines village, informed by currently available information on the levels of total heavy metals in soil.
2. Group water schemes should be subject to on-going monitoring by the relevant supervisory authority (TCC or Irish Water) to establish that lead levels comply with statutory limits; households supplied from private sources should follow advice on sampling and testing of drinking water to establish that lead levels meet statutory limits. [Information leaflets prepared by the HSE in consultation with Irish Water and the EPA]
3. A targeted programme of sampling and testing should be implemented to monitor lead levels in milk.  
[This is primarily the responsibility of dairy processors collecting milk from the Silvermines area but with oversight and verification by DAFM]
4. The programme of environmental (biological and physico-chemical) and geotechnical monitoring of the Gortmore Tailings Management Facility and other mining-related sites and local river systems should be continued.

[DCCAIE; EPA]

5. A targeted programme of sampling and testing should be implemented to monitor lead levels in tissues of other grazing animals at slaughter to complement the existing monitoring programme in cattle.  
[DAFM]
6. Suspected cases of lead poisoning in animals should be investigated:
  - Farmers and private veterinary practitioners (PVPs) attending farms should submit carcasses or tissues of fallen animals for post-mortem examination or laboratory analysis especially in instances of sudden death [Farmers; PVPs];
  - DAFM should provide laboratory diagnosis and follow-up investigations for suspected cases [DAFM].

### ***Risk Management***

7. Specific measures should be taken in the home and in the locality to protect human health by minimising human exposure to lead.  
[This is the responsibility of the local community – to follow advice and guidance provided by the HSE]
8. Specific measures should be taken at farm level to ensure safe food production and protect animal health and welfare by minimising exposure of animals to lead.  
[This is the responsibility of farmers – to follow advice and guidance provided by Teagasc]
9. Dairy farmers should be assisted in managing risk by being provided with maps of their land holdings showing the distribution of lead and/or total heavy metals in soil and with bespoke advice on soil and grassland management for their holding.  
[DAFM to provide “heat maps” on consent of the farmer to process landholding data; Teagasc to provide advice on request of the farmer]
10. Flagging of bovine animals on the Animal Identification and Movement (AIM) system should be implemented on an individual animal basis (rather than a herd basis) to ensure that offal (liver and kidney) is discarded at slaughter.  
[DAFM]
11. All premises containing equine animals should be registered and equine animals should be identified on the AIM system to ensure that offal (liver and kidney) is discarded at slaughter.  
[Registration of premises is the responsibility of owners of equine animals; enforcement of controls is the responsibility of DAFM]

12. The final phase of rehabilitation of mining-related sites, the construction of a Mine Waste Management Facility in the Silvermines area, should be completed.  
[DCCAIE]

### ***Risk Communication***

13. An annual inter-agency meeting with representatives from all relevant agencies should be convened to:
- Review the risks and monitor on-going implementation of the recommendations of this report and previous reports;
  - Review new evidence with potential impact on existing advice for local residents. [Note: *any agency may use the existing protocol to request a meeting outside of this annual schedule to share new knowledge pertaining to risk and/or to avail of the knowledge and expertise in other agencies*];
  - Ensure that the communication procedures are appropriate and on-going including:
    - i. Update of information on the website;
    - ii. Review all leaflets annually and update with any new information or evidence that has arisen since the previous review. Consider their circulation within the local community / farms as required and at a minimum every 3 years.
- [TCC to convene, host and chair this annual meeting]
14. Information and advice aimed at protecting human health should be reviewed, updated and distributed to the local community and to local health service providers on a periodic basis. [Note: *For the purposes of communication regarding health, the area of interest should be based on the 1999 study area but extended by approximately 1km to the east of Silvermines village*].  
[HSE should review, update and distribute this information, including advisory leaflets]
15. Information and advice aimed at ensuring safe food production and protecting animal health and welfare should be reviewed annually, updated and distributed to the local farming community on a periodic basis.  
[Teagasc should review, update and distribute this information, including an advisory leaflet]
16. Information and advice aimed at ensuring and verifying safe food production should be reviewed annually, updated and distributed to food business operators.  
[DAFM should review, update and distribute this information]
17. All advisory information should be proof-read by the National Adult Literacy Agency (NALA) to ensure that it is easily understood by the target audience.  
[Relevant agencies to liaise with NALA]

18. All published reports, advisory leaflets and other relevant information on active management in the Silvermines area should be readily available via a dedicated and curated web-page.

[TCC to host this web-page and update it as necessary]

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## Appendix A - Recommendations of IAG Report June 2000

| HUMAN HEALTH |  |                    |  |
|--------------|--|--------------------|--|
| No.          | Recommendation   | Agency responsible | Progress following IAG 2000 Report   |
| 1            | The school play area in Silvermines village should be resurfaced immediately. It should then be fenced in to define a safe play area.  | DES<br>NTCC        | Resurfacing was carried out, grass was sown, the basketball court was refurbished and a new tennis court was constructed. This was all completed in May 2001.  |
| 2            | Children should be discouraged from accessing other areas of high lead content.  | MWHB               | <i>What every parent should know about Lead levels in Children</i> (MWHB, 2000) was completed and distributed in February 2000. Leaflets were also circulated in 2001 and 2002 on the same topic.  |
| 3            | A programme of annual blood lead surveillance should be implemented for pre-school and school children in the Silvermines area. The results of this programme, which will commence in Autumn 2000, should be reviewed after 2-3 years of testing.  | MWHB               | Blood lead level screening was offered to all pre-school children in the study area and all school children in the five schools in the area (Silvermines, Ballywilliam, Ballinahinch, Lissenhall and Boher).<br><br>Blood samples were taken from pre-school children and primary school children in 1999, 2000 and 2001.<br><br>Average BLLs were low and levels were trending downwards in the 3 years of monitoring which meant that there was no indication to continue.                         |
| 4            | Internal and external environmental sampling should be carried out in Silvermines village on a once-off basis in Autumn 2000 for the purpose of providing additional insight into the presence and influence of lead in this particular location and thereby a more informed basis for future precautionary measures relating to human health within this population centre.   | MWHB,<br>Teagasc   | Hand-wipes were taken from children who participated in the 2002 blood screening programme.<br>Internal dust (hoover samples) was collected from each of the homes of the children who participated in the 2002 blood screening programme.<br>Soil samples were collected from the gardens of homes of children attending Silvermines National School only.<br>Sampling of household dust, internal window ledges, garden soil continued in July 2002.<br><br>This was all completed in Autumn 2002. |
| 5            | Steps must be taken to enhance and maintain public awareness of the presence and influence of lead across the Silvermines area.  | MWHB               | See recommendation no.2<br>An education officer was specifically appointed to work with the local community.<br>A contingency plan is in place in case of a major dust blow.   |
| 6            | The active involvement and assistance of the local community, and community-based organisations, should be secured in addressing lead exposure and specific prevention strategies through education on:<br>Basic hand- washing practices with a special focus on pregnant women and the parents of young families;<br>Preparation of locally grown fruit and vegetables for domestic consumption;<br>The importance of adequate dietary intake of calcium, iron and vitamin C;<br>Dust minimisation in the home. | MWHB               | EHS undertook sampling of fruit and vegetables from 1999-2003. Householders in some areas were advised not to eat home-grown lettuce. Advice on home-grown food and gardening was given in the IAG and Expert Group reports.<br>Vegetable contamination risk was assessed in 2001 and advice regarding washing was issued.<br><br>An education officer was specifically appointed to work with the local community.  |

| <b>ANIMAL HEALTH</b> |   |                           |  |
|----------------------|---|---------------------------|--|
| <b>No.</b>           | <b>Recommendation</b>   | <b>Agency responsible</b> | <b>Progress following IAG 2000 Report</b>  |
| 7                    | Further evaluation will be required on some farms with elevated blood or tissue lead concentrations in order to identify environmental and other factors contributing to lead intake. A management system designed to minimise lead intake by food animals should be drawn up by DAFRD and Teagasc for these farms. | DAFRD<br>Teagasc          | Suspect cases will be investigated as they arise on an ongoing basis. Five farms have been investigated for lead related problems since June 2000. Teagasc and the EPA undertake sampling of soils, herbage, surface water and stream sediments when required.<br><br>Farm advisory booklet on " <i>Lead and Animal Health</i> " (Teagasc, 2001) was published and circulated to farmers in March 2001. Farm soil lead maps were also circulated. A farm meeting was held on 17 <sup>th</sup> July 2001 in the Silvermines community hall.<br><br>This was completed in July 2001. |
| 8                    | Details of a generally applicable regime of grazing and other farm management controls (including access to streams etc.), designed to minimise lead intake by animals, should be made available by Teagasc to all farmers in the area.   | Teagasc                   | Farm advisory booklet on " <i>Lead and Animal Health</i> " was published and circulated to farmers in March 2001. Farm lead maps were also circulated. A farm meeting was held on 17 <sup>th</sup> July 2001 in the Silvermines community hall.<br><br>This was completed in July 2001.  |
| 9                    | In the case of calves, which have a high susceptibility to lead poisoning, particular attention should be paid to the implementation of farm management controls given in this report.  | Teagasc                   | See recommendations 7 and 8.<br><br>This was completed in July 2001.   |
| 10                   | A targeted programme of blood-sampling and analysis should continue in the area in order to more fully assess the impact of environmental lead on animal health. This will be subject to on-going review.   | DAFRD                     | This was completed.  |
| 11                   | In order to assist in the accurate identification of cases, herdowners in the area and their veterinary practitioners should make available to the RVL of DAFRD for laboratory examination, animals which are suspected of having died from lead poisoning.   | DAFRD<br>Farmers          | Farmers are encouraged to notify the RVL of fallen animals. This is on-going.  |
| 12                   | As in the case of farm animals, care should also be taken to protect the health of domestic and companion animals.  | DAFRD                     | A reference was made in the farm advisory booklet on " <i>Lead and Animal Health</i> ". This was completed and circulated in 2001.   |

| FOOD SAFETY |  |                    |  |
|-------------|--|--------------------|--|
| No.         | Recommendation   | Agency responsible | Progress following IAG 2000 Report   |
| 13          | Water used for human consumption should only be taken from supplies which comply with the standards laid down in the Drinking Water Regulations.   | NTCC               | Public drinking water supply for the area complies with national drinking water standards for lead and monitoring is on-going. Samples taken by NTCC in January 2002 had Pb levels $\leq 5 \mu\text{g/L}$ .<br>Recent sampling shows results are compliant with statutory lead level of $10 \mu\text{g/L}$ .<br>The old Shallee Group Scheme was replaced by a new source (well) in September 1999.<br>Silvermines Public Water Supply is fed from the Nenagh Regional Water Supply Scheme (source Lough Derg). This was completed in March 2002.  |
| 14          | The following steps should be taken in the preparation for human consumption of all locally-grown fruit and vegetables in order to reduce dietary exposure to lead: <ul style="list-style-type: none"> <li>- thoroughly wash all fruit and vegetables in running water of drinking quality;</li> <li>- peel potatoes prior to cooking;</li> <li>- remove the outer leaves of leafy vegetables prior to washing and consumption.</li> </ul> | MWHB               | MWHB advice given in leaflet distributed to school children in February 2000 and circulated again in 2001 and 2002 " <i>What every parent should know about Lead levels in Children – A Parents Reference Guide</i> ".<br><br>This was completed in April 2001.  |
| 15          | A further programme of fruit and vegetable sampling should be undertaken - the duration of which should be determined by reference to the results of testing as they become available.   | MWHB               | EHS undertook sampling of fruit and vegetables from 1999-2003. Householders in some areas were advised not to eat home-grown lettuce.<br>Vegetable contamination risk was assessed in 2001 and advice regarding washing was issued.<br><br>An education officer was specifically appointed to work with the local community.   |
| 16          | Milk produced from any dairy herd in the area which was not in production during the 1999 round of milk sampling should be sampled and tested when production resumes.   | DAFRD              | All dairy herds were sampled and results were within then acceptable limits. This was completed.   |
| 17          | Livers or kidneys with lead or cadmium concentrations above those permitted for human consumption should be excluded from the food chain.  | DAFRD              | Offal of bovine animals (liver and kidneys) are being discarded.   |
| 18          | Monitoring of lead concentrations in the livers and kidneys of all slaughtered animals from farms in the area - using the Cattle Movement Monitoring System (CMMS) for animal/herd identification or suitable alternative - should continue until end-2000 – at which stage the need for further monitoring will be reviewed   | DAFRD              | The monitoring of lead in muscle of animals is on-going. The programme was reviewed by DAFRD and farms in the area are now categorised into four groups for on-going analysis: <ul style="list-style-type: none"> <li>- Herds in areas of high soil lead concentrations;</li> <li>- Herds with less than 10 tissue samples taken to date;</li> <li>- Herds where sampling has been adequate and therefore excluded;</li> <li>- Herds where no tissue samples have been collected to date.</li> </ul> This was subsequently discontinued for liver and kidney as these offals are being discarded once flagged. |
| 19          | Tissue monitoring may need to be re-introduced in the future in the event of incidents giving rise to excess lead concentrations in the area, e.g. significant dust-blows or flooding.   | DAFRD              | This is on-going. See recommendation 18 above.   |
| 20          | Cadmium concentrations should be monitored in tissues (kidney) of animals from farms on which high soil cadmium concentrations have been detected.   | DAFRD              | Three farms were identified and results of samples were within acceptable limits. This is on-going.<br>Monitoring of cadmium in muscle (since 2014) and milk is on-going as part of the NRCP with no non-compliant samples to date.  |

## SOILS, HERBAGE, FORAGE AND DRINKING WATER FOR ANIMALS

| No. | Recommendation   | Agency responsible | Progress following IAG 2000 Report   |
|-----|--|--------------------|--|
| 21  | Farmers in the area should have soils analysed to establish lime requirement and nutrient status and soils should be limed to pH 6.5 if necessary and phosphate applied as required. Nitrogen should be applied to maintain a dense and healthy grass sward.   | Teagasc            | Farm advisory booklet on " <i>Lead and Animal Health</i> " was circulated to farmers in March 2001.<br><br>A farm meeting was held on 17 <sup>th</sup> July 2001.  |
| 22  | Farmers should refer to soil lead maps to determine the lead status of their soils.  | Teagasc            | Farm soil lead maps were circulated in March 2001.<br><br>Farm lead maps and advisory booklet on " <i>Lead and Animal Health</i> " were discussed at the farm meeting on 17 <sup>th</sup> July 2001.   |
| 23  | Soils, particularly on farms showing elevated soil lead concentrations, should be disturbed as little as possible. This entails avoiding poaching by animals and damage to sward by machinery.   | Teagasc<br>EPA     | Information contained in farm advisory booklet " <i>Lead and Animal Health</i> " and in Interim Report of the expert group on lead in Silvermines (EPA, 2002).<br><br>These were completed in March 2001 and April 2002, respectively.           |
| 24  | Animals should not be allowed to ingest herbage which has been heavily contaminated by soil – either by poaching, flooding or wind-blow from tailings facilities.  | Teagasc            | Farm advisory booklet on " <i>Lead and Animal Health</i> " was circulated to farmers in March 2001.  |
| 25  | Where re-seeding is required, part of the area should first be tested to ensure that re-growth occurs. Late flowering, preferably diploid ryegrass varieties which best ensure a dense sward, should be used.  | Teagasc            | Information contained in farm advisory booklet " <i>Lead and Animal Health</i> " and Interim Report of expert group on lead in Silvermines. These were completed in March 2001 and April 2002, respectively.                                     |
| 26  | Farmers should not spread sediment from drainage works on their pastures. Spoil from drainage and dredging works on the Yellow river and its tributaries should be fenced off and not spread over pastures. Pastures subject to flooding in the Yellow river catchment should not be grazed while obviously contaminated with sediments. | Teagasc<br>EPA     | Advice on sediment disposal provided in:<br>Teagasc farm advisory booklet " <i>Lead and Animal Health</i> ";<br>EPA Interim Report of the expert group on lead in Silvermines;<br>IAG June 2000 report.<br><br>This was completed by April 2002. |
| 27  | Animals should not be allowed direct access to water-courses. Drinking water for animals should be extracted from streams (e.g. by pump).  | Teagasc            | Information contained in farm advisory booklet " <i>Lead and Animal Health</i> " and Interim Report of the expert group on lead in Silvermines.<br><br>This was completed by April 2002.   |



## RIVERS, STREAMS, SEDIMENT AND DUST MONITORING

| No. | Recommendation   | Agency responsible | Progress following IAG 2000 Report  |
|-----|--|--------------------|---|
| 28  | A programme of works to rehabilitate and manage the Garryard mine complex and water discharges from the site should be drawn up and implemented  | DMNR<br>NTCC       | <p>A report entitled “<i>Management and Rehabilitation of the Silvermines Area Phase II Report: Management Options</i>” was prepared in March 2002 by SRK Consulting (SRK) for the Department of Marine and Natural Resources (DMNR). The report was presented to the Silvermines community on 2 May 2002 and a drop in session was organized at Silvermines National School on 22 May to ensure feedback from the local community. Based on public consultation, it was agreed that the Gortmore TMF site would be prioritised for rehabilitation. Conceptual and final designs for the management and rehabilitation of the Silvermines mining sites were subsequently produced by SRK and Golder Associates in 2005 and 2006-08, respectively.</p> <p>A programme of rehabilitation works costing over €11M has been completed across multiple Silvermines sites. A third and final phase of rehabilitation works was to construct a ‘Mine Waste Management Facility’ (MWMF) at Garryard. Planning for the facility was submitted in February 2010 and permission received in March 2012. Unfortunately, due to the severity of the economic downturn in 2011, the decision was taken to postpone the MWMF works until such time as sufficient funds were available to execute the full project to completion. Construction of the MWMF and rehabilitation of the Garryard site remains to be completed.</p> |
| 29  | Biological and physico-chemical monitoring should be continued on the Yellow and Kilmastulla rivers. In addition, further water sampling upstream of Silvermines village should be undertaken. Sampling in the area should be reviewed on an annual basis. | EPA<br>NTCC        | <p>Biological and physico-chemical analysis on the Kilmastulla and Yellow rivers is undertaken as part of the national water quality monitoring programme. Additional surface water and stream sediment sampling and analysis will be undertaken as required in response to animal health incidences and/or public concerns. This is on-going.</p>  |
| 30  | To avoid the disturbance of sediments, the rivers and streams in the Yellow river catchment area should not be used for recreational purposes.   | MWHB<br>NTCC       | <p>NTCC erected warning notice at Moorheads bridge. Silvermines community to notify NTCC if further notices are required to discourage recreational use of watercourses. This was completed.</p>  |
| 31  | In the short term, the current dust monitoring programme should be continued until the risk of dust blow has been eliminated.  | NTCC               | <p>A monthly monitoring programme was carried out between March 1999 and February 2002 with a total of 428 dust samples collected and analysed in the vicinity of the GTMF. Ten samples exceeded the TA Luft limit for lead, four exceeded the TA Luft limit for cadmium and one exceeded the TA Luft limit for thallium. Dust monitoring was undertaken by NRTCC and the EPA at the GTMF from 2004 to 2012.</p> <p>This monitoring is no longer required following completion of rehabilitation works at Gortmore.</p>   |
| 32  | The emergency plan to prevent dust-blows should be implemented in full.  | NTCC               | <p>Rehabilitation of the Gortmore TMF was completed in 2009. The need for this is no longer indicated.</p>  |
| 33  | A contingency plan should be prepared and available for implementation in the event of a major dust-blow incident.   | MWHB<br>NTCC       |   |

## MINE WORKINGS

| No. | Recommendation   | Agency responsible | Progress following IAG 2000 Report   |
|-----|--|--------------------|--|
| 34  | The settlement pond and tailings lagoon at Garryard, the unvegetated tailings at Shallee, and the Gortmore TMF, should all be securely fenced off until definitive rehabilitation has taken place.   | NTCC               | As part of the Silvermines rehabilitation works, various ponds and tailings areas have been securely fenced off.                   |
| 35  | Mogul will manage the Gortmore TMF under the emergency plan agreed with TNRCC, pending final rehabilitation  | NTCC               | The Gortmore TMF was the first site to be rehabilitated with a self-sustaining vegetative cover established and completed in 2009. |
| 36  | Management plans for each historic mine site in the area should be formulated by end-2000 by consultants employed by DMNR. Agreement on and implementation of management and rehabilitation plans should accord with clear timetables and should be completed within the shortest possible timeframes. If the necessary co-operation is not forthcoming from all concerned, the relevant agencies should have recourse to their statutory powers or to legal remedy. | DMNR               | Refer to recommendation 28 for detailed update.  |
| 37  | Management plans should be formulated and implemented for other sites with elevated lead concentrations in the Silvermines area which may be identified.   | DMNR<br>NTCC       |  |

## IMPLEMENTATION OF RECOMMENDATIONS

| No. | Recommendation  | Agency responsible  | Progress following IAG 2000 Report   |
|-----|---|---|--|
| 38  | An implementation group should be established and mandated to ensure that the recommendations contained in this report are implemented. Its composition should include all of the relevant agencies. It should have regard to appropriate local views and needs, and to guidelines on the management of lead in the environment. It should also maintain dialogue with the people of the area in relation to their concerns and the progress of its work. It should meet at regular intervals with the local community. | DAFRD<br>DMNR<br>EPA<br>Local Silvermines Community<br>MWHB<br>Teagasc<br>TNRCC | The Implementation Group for Silvermines (IGS) was established in December 2000 to implement the 39 recommendations of the IAG report. The group convened on three occasions and was chaired by the EPA. Three 6-monthly progress reports were presented to DAFRD and DMNR. In the final report of August 2002 36 of the 39 recommendations had been implemented in full with recommendations 28, 36 and 37 outstanding. In the meantime progress has been made on these recommendations as outlined in tables 8.5 and 8.6 above.                          |
| 39  | As a matter of priority, an expert group – to include international experts – should be established to formulate guidelines applicable to Ireland on the management of lead in the environment. The conclusion of this group, which should be asked to complete its work within a short timeframe, should be available to, and should inform the work of, the implementation group in giving effect to the recommendations contained in this report.  | EPA<br>MWHB<br>DAF<br>DCMNR<br>Teagasc<br>NTCC<br>DEHLG                         | The expert group, which included international experts, was established in June 2001. An interim report was produced in 2002 with a final report following in 2004. The final report contained 40 recommendations giving guidance in relation to human and animal health, sediment disposal, gardening, and soil and mine waste disturbance in relation to lead and other metals. Human and animal health and environmental monitoring programmes were also reviewed. The conclusions of the interim report informed the work of the implementation group. |

## Appendix B - Recommendations of Expert Group Report 2004

| APPROACH ADOPTED RECOMMENDATION |   |                                  |
|---------------------------------|---|----------------------------------|
| No.                             | Recommendation  | Progress following Expert Report |
| 1                               | <p>The Expert Group considered the various approaches to the development of guideline values and concluded that a <i>precautionary</i> approach should be adopted, with due consideration being given to published soil guideline values, based on a risk assessment approach. In arriving at its recommendations in relation to soil guideline values the Expert Group considered relevant international guideline values, such as those used in the United Kingdom and The Netherlands. The Expert Group did not consider it appropriate to recommend a blanket adoption of international soil guideline values due to the unique nature of the Silvermines area. The UK and Dutch soil guideline values were considered in the context of available information on lead exposure and uptake in the Silvermines area and, in particular, the relatively low blood lead concentrations which were identified during the human health monitoring programme conducted by the MWHB. The Group also stressed that guideline values for soil and sediment specified by it should be used in the overall context of an active management programme. These values should not be used in isolation from such an active management programme.</p> |                                  |

## RECOMMENDATIONS FOR ACTIVE MANAGEMENT

| No. | Recommendation  | Progress following Expert Report  |
|-----|---|---|
| 2   | <p>The Expert Group considers that a comprehensive "active management" programme, involving the relevant authorities and the local community, is the most effective mechanism for minimising the risk of exposure of children, adults, animals, crops and the wider environment to lead and other relevant metals. It also considers that it is important that the term "active management" be clearly defined.</p> <p>In relation to the protection of human and animal health in Silvermines, "active management" includes:</p> <ul style="list-style-type: none"> <li>- A comprehensive monitoring programme for the area which includes the monitoring of human and animal health, the monitoring of lead and other relevant metals in the environment and the monitoring of sites where remediation has been carried out. A simple checklist should be developed by NTCC as part of the monitoring programme, which would be completed periodically during a field survey of the area. Aspects which should be included in the visual check are mine site boundaries, significant construction activities, the state of streams and drains in the area, access to stream by livestock etc.;</li> <li>- Immediate investigation of any incidents that are likely to give rise to increased risk of exposure to lead or other relevant metals by humans and animals;</li> <li>- Immediate investigation of suspected lead-related animal health problems in the area;</li> <li>- Availability of emergency procedures and contingency plans in the unlikely event of a major incident occurring, e.g., major dust blow from the Gortmore TMF;</li> <li>- Reviewing and updating guidance on measures to minimise the uptake of lead and other relevant metals by humans, animals and plants;</li> <li>- Encouraging the active involvement and assistance of the local community in maintaining awareness of the potential risk from lead in the area and preventative strategies that have been put in place;</li> <li>- Appropriate dissemination of information to the local community in relation to on-going monitoring and other developments;</li> <li>- Minimising disturbance of soils in and around residential houses;</li> <li>- Minimising the disturbance of stream sediments in the area;</li> <li>- Covering of bare soils where possible to prevent the exposure of humans, particularly children, and animals to contaminated soils;</li> <li>- Minimising the disturbance of mining wastes; and</li> <li>- Encouraging the appropriate management of mining sites and sites with elevated lead and heavy metal concentrations.</li> </ul> | <p>The conclusions of the interim expert group report (2002) informed the work of the implementation group and the IAG of 2017/2018 considered the recommendations of the expert group.</p> |

## RECOMMENDATIONS FOR LEAD AND OTHER METALS IN GARDEN AND AGRICULTURAL SOIL AND SEDIMENTS

| No. | Recommendation   | Progress following Expert Report   |
|-----|--|--|
| 3   | The Expert Group recommends a soil guideline value for lead of 1000 mg/kg <sub>DW</sub> for garden soils, for the protection of human health. Where this guideline value is exceeded, active management should be initiated.   | Human advisory leaflet outlining measures to limit exposure to lead to protect health and a specific leaflet on child health were distributed within the Community.  |
| 4   | The Expert Group recommends the adoption of the UK Soil Guideline Value for cadmium in garden soil of 1 to 8 mg/kg <sub>DW</sub> , depending on pH of the soil. Where the guideline value is exceeded active management should be initiated.   | Cadmium was not considered by the current IAG.   |
| 5   | The Expert Group approves the recommendations and guidance contained in the IAG report in relation to the preparation and consumption of locally grown fruit, including wild berries and vegetables, in the Silvermines area.  | EHS undertook sampling of fruit and vegetables from 1999-2003. Householders in some areas were advised not to eat home-grown lettuce.<br>Vegetable contamination risk was assessed in 2001 and advice regarding washing was issued.<br><br>An education officer was specifically appointed to work with the local community.   |
| 6   | The Expert Group agreed with the IAG report value of 1000 mg/kg <sub>DW</sub> lead in soils as a guideline value below which toxicity problems in grazing animals are unlikely to occur. On farms where lead concentrations in soils exceed 1000 mg/kg <sub>DW</sub> , good farming practices to minimise the risk of lead ingestion should be implemented with particular attention paid to young animals, which appear to be more susceptible to lead poisoning. | Farm advisory booklet on " <i>Lead and Animal Health</i> " was circulated to farmers in March 2001.  |
| 7   | The Expert Group considers that the risks to children or adults from in-situ or recently dredged sediments are very low, due to the fact that exposure to sediments is very unlikely. In addition, the Expert Group considers that the steps specified by it, in relation to active management for sediments for the protection of animal health, are sufficient to ensure that human health is protected and the risks are minimised.                             | To avoid the disturbance of sediments NTCC erected warning notice at Moorheads bridge. Silvermines community to notify NTCC if further notices are required to discourage recreational use of watercourses.<br>Human advisory leaflet outlining measures to limit exposure to lead to protect health discourages people from swimming in rivers or streams.<br>Farm advisory booklet on " <i>Lead and Animal Health</i> " was circulated to farmers in March 2001. |
| 8   | The Expert Group considers it appropriate that a similar guideline value should be used for lead in sediments as in soils, i.e., 1000 mg/kg <sub>DW</sub> , for the protection of animal health. Above this guideline value, active management should be undertaken in relation to the protection of animal health.  | Farm advisory booklet on " <i>Lead and Animal Health</i> " was circulated to farmers in March 2001.  |
| 9   | The Expert Group considered that the risks posed to animal health by recently dredged sediment containing arsenic, cadmium, copper, mercury and zinc were minimal in comparison to the risk posed by lead. The Group therefore, does not consider it necessary to recommend guideline values in relation to sediments for the other heavy metals.  | Arsenic, cadmium, copper, mercury and zinc were not considered by the current IAG.   |
| 10  | Animals should not be allowed direct access to watercourses where the lead concentration of the sediments is greater than 1000 mg/kg <sub>DW</sub> .   | Farm advisory booklet on " <i>Lead and Animal Health</i> " was circulated to farmers in March 2001.  |

## RECOMMENDATIONS FOR ECOSYSTEM PROTECTION

| No. | Recommendation  | Progress following Expert Report  |
|-----|---|---|
| 11  | <p>The Expert Group discussed the issue of guideline values in relation to ecosystem protection in the Silvermines area. Due to the presence of mineralised veins in the host rocks and as a result of centuries of mining activity in the area, the Expert Group agreed that it would confine itself to considering guideline values for the protection of human and animal health. It was felt that ecosystems in the area may have adapted to the unusual geochemical conditions, the mining legacy and elevated heavy metal concentrations, and that the imposition of guideline values for the protection of ecosystems in near pristine conditions would be inappropriate. Further research would be needed to investigate the usefulness of, and possibilities for, developing appropriate ecological guideline values for the Silvermines area.</p> | <p>The Silvermines area has naturally elevated metal levels including lead. The natural ecosystem therefore develops in the naturally occurring conditions. Metallophytic bryophytes occurrences have been identified in the area.</p> <p>It is not practical or proportionate to consider guideline values for ecosystem protection particularly given that some ecosystems require elevated metal levels.</p> |

## RECOMMENDATIONS FOR LEAD AND OTHER METALS IN DUST

| No. | Recommendation  | Progress following Expert Report  |
|-----|---|---|
| 12  | <p>The Expert Group approves the use of the revised German TA Luft Regulations for setting limits for lead, cadmium, arsenic, nickel, mercury and thallium concentrations in deposited dust in the external environment.</p>  | <p>A monthly monitoring programme was carried out between March 1999 and February 2002 with a total of 428 dust samples collected and analysed in the vicinity of the GTMF. Ten samples exceeded the TA Luft limit for lead, four exceeded the TA Luft limit for cadmium and one exceeded the TA Luft limit for thallium. Dust monitoring was undertaken by NRTCC and the EPA at the GTMF from 2004 to 2012.</p> <p>This monitoring is no longer required following completion of rehabilitation works at Gortmore.</p> |
| 13  | <p>The Expert Group recommends that the results from the internal dust monitoring, both in houses and the school, should be circulated to the Silvermines community once an evaluation of the findings has been carried out. The need for further dust monitoring and the frequency of such monitoring should be evaluated by the MWHB.</p> | <p>Internal dust (hoover samples) was collected from each of the homes of the children who participated in the 2002 blood screening programme. Sampling of household dust and internal window ledges continued in July 2002.</p> <p>This was all completed in Autumn 2002.</p>  |

## RECOMMENDATIONS FOR LEAD IN HUMAN AND ANIMAL BLOOD

| No. | Recommendation  | Progress following Expert Report  |
|-----|---|---|
| 14  | <p>The Expert Group agrees to the use of 10µg/dl as the current acceptable threshold for blood lead concentration. The MWHB should continue to monitor developments in this area and should take appropriate steps if the threshold is revised in the future.</p> | <p>The reference value for blood lead concentration in humans has decreased from 10 µg/dl to 5 µg/dl (ACCLPP, 2012).</p>          |
| 15  | <p>In relation to animal health, the Expert Group considers 0 to 1.2 µmol/L (25 µg/dl) lead to be the normal range for blood lead concentrations in animals.</p>  | <p>The current IAG considers 0 to 1.2 µmol/L (25 µg/dl) lead to be the normal range for blood lead concentrations in animals.</p> |

## RECOMMENDATIONS FOR LEAD, CADMIUM AND ARSENIC IN FOODSTUFFS

| No. | Recommendation  | Progress following Expert Report  |
|-----|---|---|
| 16  | <p>The Expert Group noted the new regulations in relation to the permitted concentration of lead and cadmium in foodstuffs (EC No.466/2001) and the associated Directive on sampling and analysis (2001/22/EC) and Health (Arsenic and Lead in food) Regulations, 1972. DAF has incorporated these limits and the principles of the associated Directive on sampling and analysis into the National Plan to monitor heavy metal residues in animal produce.</p> | <p>The new regulations in relation to the permitted concentration of lead and cadmium in foodstuffs and the methods of sampling and analysis are 2006/1881/EC (EC, 2006) and 2007/333/EC (EC, 2007) and are incorporated in to the NRCP to monitor heavy metal residues in animal produce in accordance with Council Directive 96/23/EC (EC, 1996).</p> |

## RECOMMENDATIONS FOR HUMAN AND ANIMAL HEALTH

| No. | Recommendation   | Progress following Expert Report  |
|-----|--|---|
| 17  | The Expert Group considers that the current guidance in relation to human health in the environment of Silvermines is adequate. The education and awareness campaign in the Silvermines area, which is implemented by the MWHB, should continue to be provided through the on-going work of local health care workers. Guidance documents should be reviewed regularly and should take account of the results of human health monitoring as they become available.   | <i>What every parent should know about Lead levels in Children</i> (MWHB, 2000) was completed and distributed in February 2000. Leaflets were also circulated in 2001 and 2002 on the same topic. An education officer was specifically appointed to work with the local community. |
| 18  | The Expert Group reviewed the guidance on animal health, which is available to the farming community in the Silvermines area and considers that the current guidance covers the majority of relevant issues. The Expert Group stressed the importance of preventing animal access to mine wastes, bare soils and stream sediments.   | Farm advisory booklet on " <i>Lead and Animal Health</i> " was circulated to farmers in March 2001.   |
| 19  | Dredged sediments with lead concentration of greater than 1000 mg/kg <sub>DW</sub> should not be spread on adjacent land or be piled alongside streams and rivers where animals can gain access to the dredgings.  | Farm advisory booklet on " <i>Lead and Animal Health</i> " was circulated to farmers in March 2001. Farmers are advised that dredged sediments should be placed within fenced area adjacent to drains and never on pastures.  |
| 20  | The Expert Group agrees with the recommendation, contained in the IAG report, that drinking water for animals should be extracted from streams by using a mechanism which avoids disturbing in-situ stream sediments, e.g., by pump and filtering system. This should be done preferably from a stretch of stream in which the concentration of lead in sediment is less than 1000 mg/kg <sub>DW</sub> and where sediment disturbance can be avoided. Turbid water (indicating sediment in suspension) should never be used as a water supply for animals. | Farm advisory booklet on " <i>Lead and Animal Health</i> " was circulated to farmers in March 2001.   |

## RECOMMENDATIONS FOR SEDIMENT DISPOSAL

| No. | Recommendation  | Progress following Expert Report  |
|-----|---|---|
| 21  | The Expert Group recommends that the mining sites contributing contaminated sediments to the watercourses in the area, in particular those in the Yellow River catchment, should be rehabilitated and managed in accordance with the SRK report <i>Management and rehabilitation of the Silvermines area</i> . This will help to provide a long-term solution to the generation of sediments and a safe waste management disposal facility for dredged sediments.   | A programme of rehabilitation works costing over €11M has been completed across multiple Silvermines sites. Following public consultation, it was agreed that rehabilitation works would first be completed at the Gortmore TMF. A second major phase of works then focused on completing safety works at the Ballygown, Magcobar, Garryard, Gorteenadiha and Shallee sites (e.g. making shafts safe, demolishing derelict buildings and structures, fencing off ponds and open pits, etc.). A final phase of works, the construction of a Mine Waste Management Facility (MWMF) and associated passive treatment system (PTS) at Garryard, was postponed due to the severity of the 2011 economic downturn. Once constructed, this facility will serve as a repository for mining wastes from various sites and help to eliminate the release of contaminated sediments into the Yellow River catchment. |
| 22  | The Expert Group recommends that stream sediments should be sampled and analysed to determine their concentration of lead and other relevant metals before drainage works are undertaken. This is required to determine the most appropriate method of disposal.  | During and upon completion of the rehabilitation works prepared by SRK (UK) Ltd., and as part of the final design solution, an extensive monitoring programme of stream sediments etc. was carried out as outlined in the <i>“Rehabilitation Plan for the Gortmore TMF, Silvermines, Co. Tipperary”</i> (Golder Associates, 2007). During and post rehabilitation phases, monitoring of stream sediments was carried out quarterly and bi-annually, respectively.   |
| 23  | The Expert group recommends that sediments which have a lead concentration greater than 1000 mg/kg <sub>DW</sub> should not be disposed of to agricultural land, either along the bank or spread onto adjacent lands. As a temporary measure only, these sediments may be left in-situ until a safe waste management disposal option, which complies with relevant statutory requirements, is found. However, there may be an increased risk of flooding with the consequential spreading of sediments onto adjacent agricultural lands by floodwaters. Further guidance is given in the Teagasc booklet <i>Lead Animal Health</i> (Teagasc, 2001). | Farm advisory booklet on <i>“Lead and Animal Health”</i> was circulated to farmers in March 2001. Farmers were advised that dredged sediments should be placed within fenced area adjacent to drains and never on pastures.   |
| 24  | Where stream sediments with a lead concentration of less than 1000 mg/kg <sub>DW</sub> are dredged and disposed of to adjacent agricultural land, the Expert Group recommends that the ground be rolled after spreading and that the area should not be grazed until grass re-growth is greater than 12 cm in height.   | Farm advisory booklet on <i>“Lead and Animal Health”</i> was circulated to farmers in March 2001. Farmers were advised that dredged sediments should be placed within fenced area adjacent to drains and never on pastures.   |



## RECOMMENDATIONS FOR GARDENING

| No. | Recommendation  | Progress following Expert Report  |
|-----|---|---|
| 25  | The Expert Group recommends that where the concentration of lead in garden soils is greater than 1000 mg/kg <sub>DW</sub> , and where vegetables are to be grown, clean soil should be imported and spread to a depth of 30cm in the area in which vegetables are currently grown and in potential future areas of cultivation.   | The current IAG concluded that direct measurement of lead levels in animal tissues and in food is the most appropriate means of monitoring and assessing risk. The Expert Group report of 2004 recommended additional work and research needs including <i>“Studies into lead and cadmium uptake by edible plants in the Silvermines area coupled with the application of chemical extraction procedures, to determine the bioavailability of these metals and the potential risks”</i> . |
| 26  | In gardens where no vegetables are grown but where soil lead concentration is greater than 1000 mg/kg <sub>DW</sub> , bare soils should be covered with vegetation or other appropriate media, such as bark mulch.  |   |
| 27  | In relation to cadmium in garden soils, the Expert Group recommends the following active management steps: <ul style="list-style-type: none"> <li>- where cadmium concentration is below 8 mg/kg<sub>DW</sub>, soils should be limed to raise and maintain the soil at or above pH 7;</li> <li>- where cadmium concentrations are greater than 8 mg/kg<sub>DW</sub>, vegetables should be tested to determine the concentration of cadmium in home-grown vegetables. Where the concentration in the vegetables is below the maximum permitted levels as outlined in Commission Regulation No 466/2001, soils should be limed to ensure that the pH is at 7 or above;</li> <li>- where cadmium concentrations in home-grown vegetables exceed the maximum permitted levels, as outlined in Commission Regulation No 466/2001, clean soil should be imported and spread to a depth of 30 cm in current and future vegetable growing areas of the garden.</li> </ul> | Cadmium was not considered by the current IAG. However, the same observations outlined in recommendations 25/26 pertain.  |
| 28  | The Expert Group recommends that where fruit and vegetables are grown in the Silvermines area for home consumption, the MWHB should offer a service to the local community to have these sampled and analysed for lead and cadmium to establish where clean soil may have to be imported into gardens.  | EHS undertook sampling of fruit and vegetables from 1999-2003. Householders in some areas were advised not to eat home-grown lettuce. Vegetable contamination risk was assessed in 2001 and advice regarding washing was issued.  |
| 29  | The Expert Group recommends that where fruit and vegetables are grown locally, the guidance given in the IAG report should be adopted. That is, thoroughly wash all fruit, including wild berries and vegetables in running water of drinking quality; peel potatoes and all root vegetables prior to cooking; and remove the outer leaves of leafy vegetables prior to washing and consumption.  | An education officer was specifically appointed to work with the local community.   |
| 30  | The Expert Group recommends that garden soil fertility levels should be maintained or enhanced where necessary, particularly in relation to the adequacy of lime (i.e., pH 7 or above) and phosphorus.  |   |

## RECOMMENDATIONS FOR SOIL DISTURBANCE IN RELATION TO CONSTRUCTION AND AGRICULTURAL ACTIVITIES AND MINE WASTE DISTURBANCE

| No. | Recommendation   | Progress following Expert Report   |
|-----|--|--|
| 31  | <p>The Expert Group recommends the following best practice in relation to soil disturbance:</p> <ul style="list-style-type: none"> <li>- reference should be made to building codes, current planning regulations and health and safety regulations, which would be relevant, for example, to site workers engaged in site clearance and construction activities where contamination is expected;</li> <li>- bare areas of soil should be kept to a minimum during soil disturbance operations, such as, construction works etc.;</li> <li>- bare soils on sites should be dampened with water during weather conditions which favour the generation of dust on site; and</li> <li>- once works have been completed on sites, bare soils should be covered over to minimise the potential risk to human and animal health, e.g., sown with grass.</li> </ul> | <p>This recommendation is followed in all areas under TCC's control.</p>   |
| 32  | <p>The Expert Group recommends that appropriate conditions should be attached to any planning permission relating to developments that require disturbance of soils in the area.</p>   | <p>Planning permissions which are granted and which involve extensive soil disturbance are conditioned to make it obligatory on the developer to take account of the recommendations of the Expert Group.</p>  |
| 33  | <p>The Expert Group recommends that soil fertility levels be determined prior to reseeded and that these levels should be maintained or improved where necessary. It should be noted that elevated zinc and cadmium concentrations might affect germination and the establishment of grass.</p>  | <p>Farm advisory booklet on "<i>Lead and Animal Health</i>" was circulated to farmers in March 2001.</p>   |
| 34  | <p>The Expert Group recommends the following in relation to ploughing and reseeded where this is to be undertaken:</p> <ul style="list-style-type: none"> <li>- reseed in the Autumn with late diploid perennial rye grass;</li> <li>- apply fertiliser based on Teagasc current nutrient advice;</li> <li>- roll after emergence;</li> <li>- in Spring, if growth is uneven, top herbage, apply fertiliser, roll and take an early silage crop; and</li> <li>- after a silage cut is taken, roll, apply nitrogen and allow re-growth for 3 to 4 weeks before grazing.</li> </ul>  | <p>Farm advisory booklet on "<i>Lead and Animal Health</i>" was circulated to farmers in March 2001.</p>   |
| 35  | <p>The Expert Group recommends that farmers in the area should avoid poaching the land during the winter months and at other times when the soil becomes saturated. This would minimise the risk of exposure of animals to bare soils with elevated lead concentrations.</p>   | <p>Farm advisory booklet on "<i>Lead and Animal Health</i>" was circulated to farmers in March 2001.</p>   |
| 36  | <p>The Expert Group recommends that unplanned disturbance of mine waste should not take place due to the risk of releasing pollutants to the environment. In the Silvermines area, mine waste should only be disturbed where it is part of a planned and authorised remediation programme.</p>   | <p>Rehabilitation works have been largely completed at all sites, with the exception of Garryard. Residual mine waste from various sites will be contained in the Garryard MWMF, following its construction. In the interim, mining wastes should not be disturbed as per the advice of the Expert Group.</p>  |
| 37  | <p>Where approval for mine waste disturbance is granted as part of a remediation programme for the area, precautions should be taken to minimise the risk of exposure to humans, animals and the environment from lead and other relevant metals.</p>  | <p>In mid-2006 NTCC appointed Golder Associates to finalise the designs and manage the implementation of the rehabilitation programme as set out in SRK's 2002 conceptual design. Their report (Golder Associates, 2007) outlined measures to be taken to minimise the risk of exposure to humans, animals and the environment from lead and other relevant metals during the remediation programme.</p> |

## RECOMMENDATIONS FOR SOIL DISTURBANCE IN RELATION TO CONSTRUCTION AND AGRICULTURAL ACTIVITIES AND MINE WASTE DISTURBANCE

| No. | Recommendation   | Progress following Expert Report   |
|-----|--|--|
| 38  | The Expert Group recommends that where there is a potential for the exposure of children to bare soils in playgrounds or play areas, soils should be sampled and analysed for lead. Where the concentration is greater than 1000 mg/kg <sub>DW</sub> , appropriate measures should be taken to ensure that exposure to bare soil is minimised, e.g., grass cover in the area should be established and maintained.   | In the play area of Silvermines village resurfacing was carried out, grass was sown, the basketball court was refurbished and a new tennis court was constructed. This was all completed in May 2001.<br><i>What every parent should know about Lead levels in Children</i> (MWHB, 2000) was completed and distributed in February 2000. Leaflets were also circulated in 2001 and 2002 on the same topic.   |
| 39  | In relation to playing fields, the Expert Group recommends that grass cover should be maintained or improved, where necessary, to minimise risk of exposure to bare soil.  | The school playing field in Silvermines village was re-laid with imported topsoil.   |
| 40  | The screening programme undertaken by the MWHB in 1999, 2000 and 2001, has shown the blood lead concentrations in children are declining in the area and are below the threshold value of 10µg/dl. The Expert Group considers that there is little to be gained from continued monitoring of blood lead levels, particularly due to the invasive nature of such monitoring. The need for monitoring blood lead levels or the use of hand wipes should, however, be reviewed if an event occurs which indicates an increased risk to the community. | Blood lead level screening was offered to all pre-school children in the study area and all school children in the five schools in the area (Silvermines, Ballywilliam, Ballinahinch, Lissenhall and Boher).<br><br>Blood samples were taken from pre-school children and primary school children in 1999, 2000 and 2001.<br><br>Average BBLs were low and levels were trending downwards in the 3 years of monitoring which meant that there was no indication to continue with this programme. No further sampling was undertaken. |

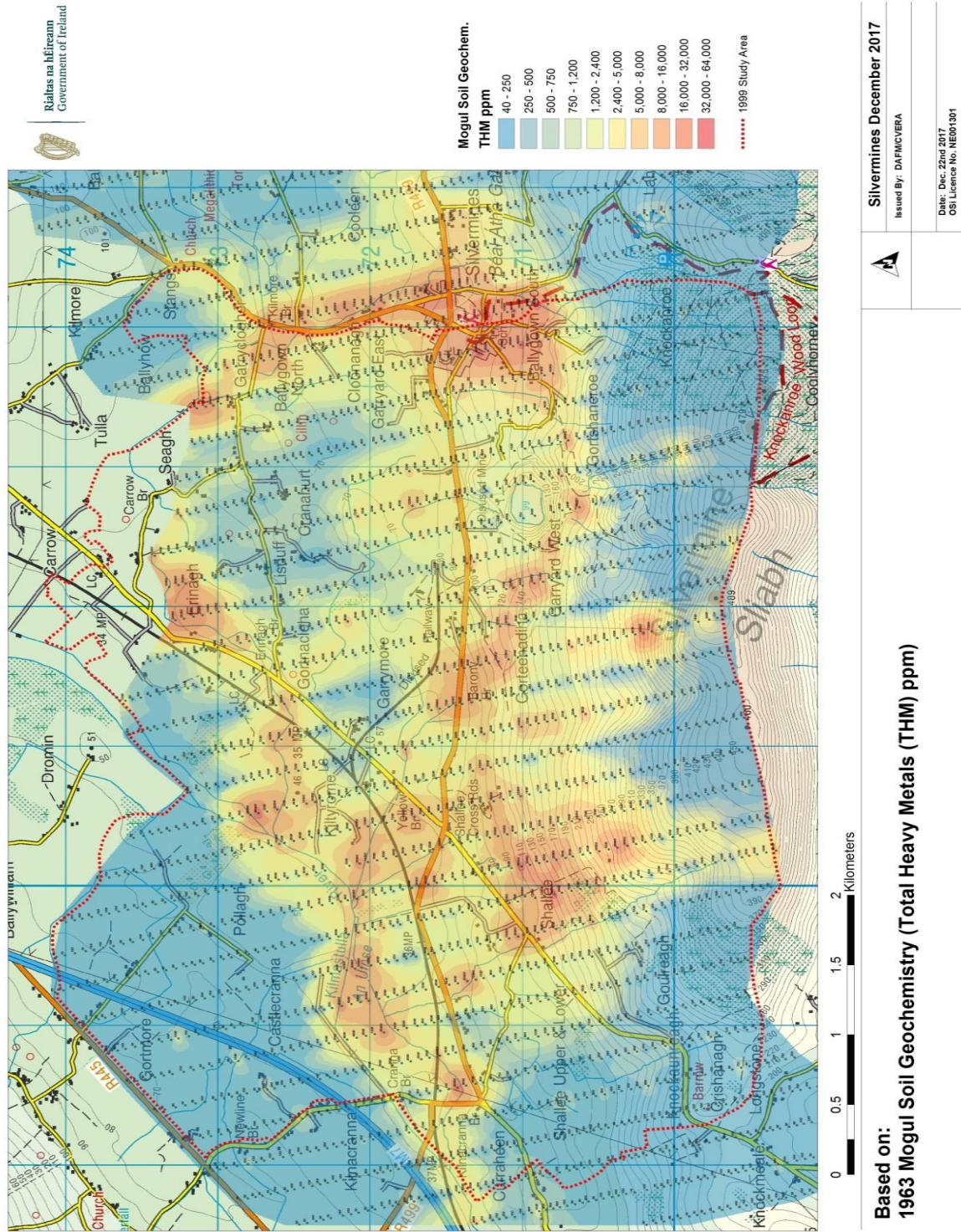
## Appendix C – Maximum Limits for Lead (Regulation 1881/2006/EC)

| Foodstuff |  | Maximum Levels<br>(mg/kg wet weight) |
|-----------|--|--------------------------------------|
| 1         | Raw milk ( 6 ), heat-treated milk and milk for the manufacture of milk-based products  | 0,020                                |
| 2         | Infant formulae and follow-on formulae:<br>marketed as powder  | 0.050                                |
|           | marketed as liquid   | 0.010                                |
| 3         | Processed cereal-based foods and baby foods for infants and young children other than 5  | 0.050                                |
| 4         | Foods for special medical purposes intended specifically for infants and young children<br>marketed as powder  | 0.050                                |
|           | marketed as liquid   | 0.010                                |
| 5         | Drinks for infants and young children labelled and sold as such, other than those mentioned in 2 and 4   |                                      |
|           | marketed as liquids or to be reconstituted following instructions of the manufacturer including fruit juices<br>to be prepared by infusion or decoction  | 0.030<br>1.50                        |
| 6         | Meat (excluding offal) of bovine animals, sheep, pig and poultry   | 0.10                                 |
| 7         | Offal of bovine animals, sheep, pig and poultry  | 0.50                                 |
| 8         | Muscle meat of fish  | 0.30                                 |
| 9         | Cephalopods  | 0.30                                 |
| 10        | Crustaceans  | 0.50                                 |
| 11        | Bivalve molluscs   | 1.50                                 |
| 12        | Cereals and pulses   | 0.20                                 |
| 13        | Vegetables excluding leafy brassica, salsify, leaf vegetables & fresh herbs, fungi, seaweed and fruiting vegetables  | 0.10                                 |
| 14        | Leafy brassica, salsify, leaf vegetables excluding fresh herbs and the following fungi<br><i>Agaricus bisporus</i> (common mushroom), <i>Pleurotus ostreatus</i> (Oyster mushroom),<br><i>Lentinula edodes</i> (Shiitake mushroom) | 0.30                                 |
| 15        | Fruiting vegetables  |                                      |
|           | sweetcorn<br>other than sweetcorn  | 0.10<br>0.05                         |
| 16        | Fruit excluding cranberries, currants, elderberries and strawberry tree fruit  | 0.10                                 |
| 17        | Cranberries, currants, elderberries and strawberry tree fruit  | 0.20                                 |
| 18        | Fats and oils, including milk fat  | 0.10                                 |
| 19        | Fruit juices, concentrated fruit juices as reconstituted and fruit nectars<br>exclusively from berries and other small fruits  |                                      |
|           | from fruits other than berries and other small fruits  | 0.05<br>0.03                         |
| 20        | Wine (including sparkling wine, excluding liqueur wine), cider, perry and fruit wine<br>products produced from the 2001 fruit harvest to 2015 fruit harvest  |                                      |
|           | products produced from the 2016 fruit harvest onwards  | 0.20<br>0.15                         |
| 21        | Aromatised wine, aromatised wine-based drinks and aromatised wine-product cocktails<br>products produced from the 2001 fruit harvest to 2015 fruit harvest   |                                      |
|           | products produced from the 2016 fruit harvest onwards  | 0.20<br>0.15                         |
| 22        | Food supplements   | 3.0                                  |
| 23        | Honey  | 0.10                                 |



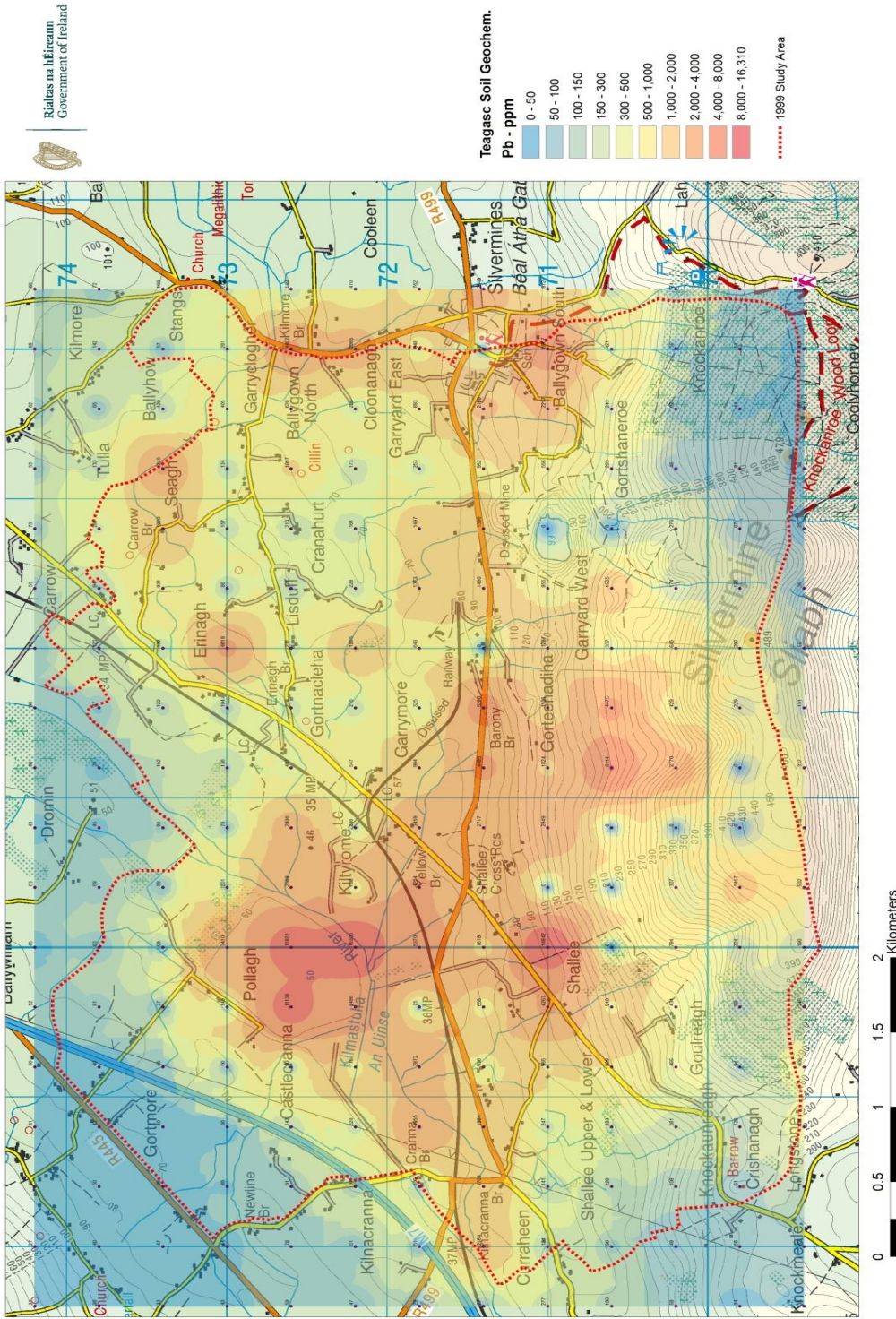
# Appendix D – Maps Illustrating Concentration of Heavy Metals in Soils in the Silvermines Area

## Map 1: Levels of Total Heavy Metals in Soil in the Silvermines Area





**Map 2: Levels of Lead in Soil in the Silvermines Area**



Riadas na hÉireann  
Government of Ireland

**Silvermines December 2017**  
Issued By: DAFMC/VERA

**North Arrow**

**Based on:  
2000 Teagasc Soil Geochemistry (Lead - ppm)**

Date: Dec 2017  
OSI Licence No. NE001301



**Map 3: Levels of Lead in Soil in Sragh and Neighbouring Townlands**

