

## Part 2A, Environmental Protection Act 1990

### Technical Guidance on normal levels of contaminants in Welsh soil

Normal levels of contaminant concentrations in soils are referred to in the contaminated land Statutory Guidance for the Part 2A regime (Wales), published by Welsh Government, 2012. This technical guidance gives an indication as to what mercury concentrations can be expected in soils based on results from samples systematically collected across Wales. Normal Background Concentrations (NBCs) can be used along with other criteria (e.g. site investigation data and risk assessments) to help decide whether land is contaminated land as defined by Part 2A, on a site-by-site basis.

**The NBCs are not intended to be a tool to be utilised when undertaking works via the planning regime.** They are contaminant concentrations that are seen as typical and widespread in topsoils (depth 0 – 15 cm) and include contributions from both natural and diffuse anthropogenic sources. When using this Guidance, please refer to the section on 'Using Normal Background Concentrations' on page 3, the supplementary information provided by Ander et al. (2013), and the revised Part 2A Statutory Guidance (Wales).

## MERCURY (Hg)

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Mercury (Hg) is a metallic element present in small quantities (typically 0.02 mg/kg) in the rocks of the Earth's crust. It is a highly toxic element, although its toxicity depends on its chemical form and the route of exposure. Several forms of Hg occur naturally in the environment, the most abundant natural forms of Hg being metallic Hg, cinnabar (HgS), Hg chloride (HgCl<sub>2</sub>), and methylmercury (CH<sub>3</sub>Hg). Mercury associates strongly with organic matter in soils and is relatively immobile and persistent. The major loss pathway from soils is as gaseous mercury.

Generally, atmospheric deposition is the prevalent source of background Hg entering the soil, with natural sources, particularly volcanoes, accounting for about half the background Hg input to soils, and the remainder coming from human activities, largely combustion (e.g. coal-burning power stations).

The use of Hg has declined overall in recent decades as its extreme toxicity to humans and the environment has become increasingly apparent. The persistence of Hg means that past anthropogenic activities, such as metal smelting and industries employing mercury, may have left a long term legacy of locally contaminated soils. In the past, uses of Hg included thermometers, hat making, the chloralkali process (for the manufacture of sodium and chlorine), gold mining and batteries. Continuing uses include dental amalgam, as a preservative agent in vaccines and in fluorescent lamps.

#### NORMAL BACKGROUND CONCENTRATIONS (NBCs)

Domain	Area (km <sup>2</sup> )	Area (%)	NBC (mg/kg)	n
Principal	20,600	97	0.25	104
Urban	600	3	nd	7

Table 1: NBCs for the Hg domains (cited to 2 significant figures, n is number of samples used in the calculation). Hg is determined on topsoils using results from Wales. The NBC is the upper 95% confidence limit of the 95<sup>th</sup> percentile of the domain data. (nd = not determined because n < 30).

## Methods

NBCs for Hg are calculated using contaminant data, with demonstrably high levels of quality assurance, for topsoils systematically collected from a variety of land uses and analysed using certified methods. Availability of Hg results in Welsh soils is very scarce when compared with other inorganic contaminants, particularly with regard to results from projects that have not been targeted specifically at industrial land uses. The principal data sets used for the NBC determination of other inorganic contaminants (G-BASE and NSI) have not been used either because Hg was not determined or the lower limit of the analytical method is unacceptably high. Instead, results from a number of other different surveys have been combined (Figure 1). The inherent problem with these surveys is that they have targeted specific geographical areas or land uses and they cannot be considered as truly systematically collected. Also studies such as the Countryside Survey (CS) report multiple sample results over a small area so sites shown in Figure 1) may represent multiple samples. Furthermore, the site locations for the CS and Soil and Herbage Survey (SHS) are reported to  $\pm 10$  km so Hg results cannot be used to a resolution better than this. Topsoil Hg results from low density European-wide systematic surveys have also been used (FOREGS and GEMAS, see Ander *et al.* 2013).

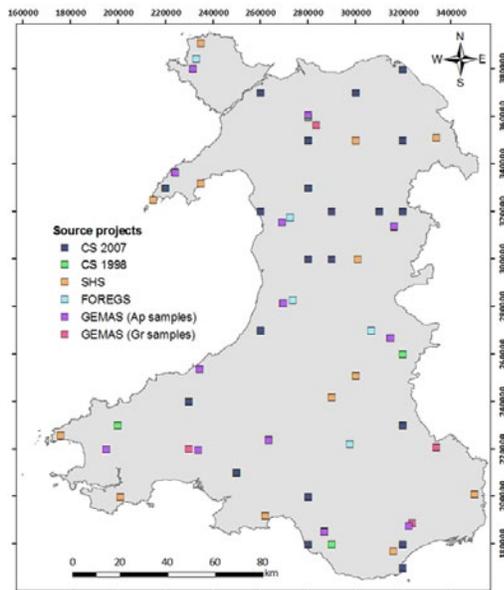


Figure 1: Map showing the distribution of sites for samples used in the Hg NBC determination. The different data sets are described in the supplementary report (Ander *et al.* 2013).

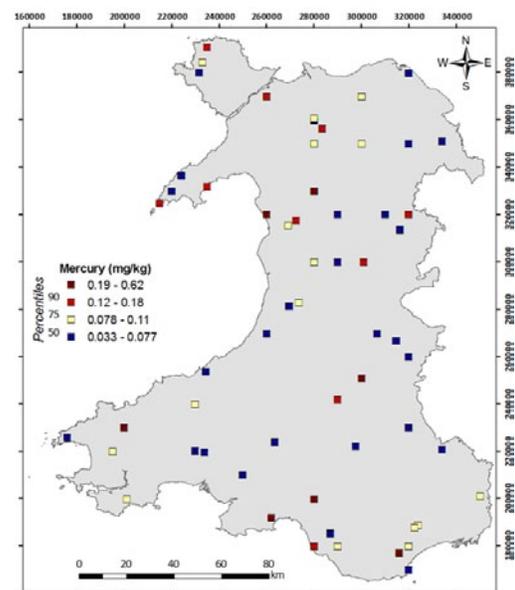


Figure 2: Hg in topsoil as a percentile classified map.

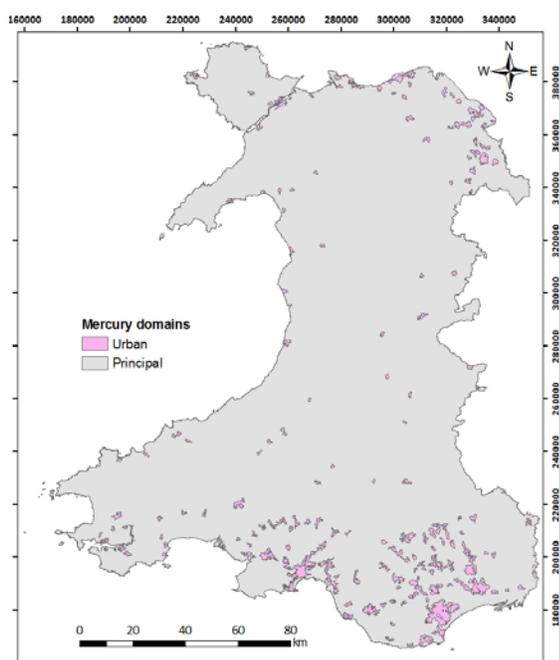
Welsh soils have developed on a diverse range of parent materials, though the geogenic contribution to soils cannot be recognised in the available data when compared to Hg added through human activity. Soils have also been subjected to a long history of diffuse pollution from industry and general urban activities. This has given rise to variability in the Hg distribution across Wales (Figure 2).

For the majority (non-urban) Hg topsoil results explored, a range of 0.03 – 0.62 mg/kg is reported, with a mean and median of 0.10 and 0.08 mg/kg, respectively. Although the number of Hg topsoil results available to determine a NBC concentration for the Urban Domain is insufficient, targeted industrial areas (e.g. from the Soil and Herbage

Survey, median 0.26 mg/kg) would suggest an enrichment of Hg in urban areas. Coal-burning is considered to be a major industrial and domestic source (see Ander *et al.* 2013). There are also insufficient data to recognise any domain associated with non-ferrous metalliferous mineralisation and mining in Wales and the type of minerals associated with the Welsh orefields are unlikely to give rise to elevated levels of Hg.

In order to establish meaningful NBCs, soils are grouped in domains, defined by the most significant controls on a contaminant's higher concentrations and distribution. With the low number of results available for NBC calculations, the confidence intervals for the Hg percentiles are large. NBCs are determined for each domain using robust statistical analysis that investigates the distribution of results and, by a process of iteration, takes into account the results that may be associated with point source contamination. Normal levels of Hg are represented here by the upper 95% confidence limit of the 95<sup>th</sup> percentile, *i.e.* the NBC value is the upper limit at or below which contaminant levels can be considered to be normal for the defined domain.

## Results



Exploration of Welsh soil data shows that the Hg NBCs are best defined by two domains - Urban and Principal Domains (Figure 3 and Table 1). However, insufficient appropriate data is available to quantify the Urban Domain. The NBC (1.9 mg/kg) for this domain in England (Defra, 2012) should be used as guidance until this knowledge gap relating to Hg concentrations in urban topsoils is addressed.

Figure 3: Hg domain map.

## USING NORMAL BACKGROUND CONCENTRATIONS

The NBCs are produced to support the Part 2A contaminated land Statutory Guidance (SG) (Wales) and help inform as to what are normal levels of contaminants. Using this guidance, along with the further information and resources provided, a NBC test can be carried out:

1. A soil sample under investigation for Hg concentration should be spatially located in one of the two domains described. This should be part of a preliminary step in which the scenario and conceptual site model are considered.
2. If the Hg concentration is at or below the NBC for the specified domain then “*the result should not be considered to cause the land to qualify as contaminated land, unless there is a particular reason to consider otherwise*”

(SG, Section 3.22). If the latter applies, then proceed to the use of other screening tools or further site investigation as necessary and appropriate.

3. If there is no reason “to consider otherwise” then the decision can be made that there is no evidence that the land is contaminated under Part 2A with respect to Hg (SG, Sections 5.2 – 5.4), that is, the land lies outside Categories 1 or 2.
4. If the Hg concentration is above the domain NBC then using the additional resources, including those provided with this technical guidance, a more detailed investigation at a local scale should be carried out or the use of other screening tools considered as appropriate. This is to determine whether the concentrations reflect “levels of contaminants in the soil that are commonplace and widespread....and for which....there is no reason to consider that there is an unacceptable risk” (SG, Section 3.21). If this is so, then step 3 applies. In the case of Hg, for example, this may be an area within the Principal Domain where a particular land use has caused widespread low level diffuse pollution.
5. If the concentration of Hg in the soil is not considered to be commonplace and widespread then further testing is required (apply quantitative risk assessment (QRA)).

## FURTHER RESOURCES

Additional resources on NBCs are available from the BGS project [website](#). These resources include: project reports; a database of essential information about relevant soil data sets; technical guidance sheets for other contaminants; polygons defining domain boundaries in various GIS formats; and a project bibliography.

## THIS GUIDANCE SHOULD BE READ IN CONJUNCTION WITH THE FOLLOWING:

### Part 2 A documents:

Part 2A of the Environmental Protection Act 1990, as amended. The Contaminated Land (Wales) (Amendment) Regulations 2012 (Statutory Instrument 2012 No 263) (Amends Contaminated Land (Wales) Regulations 2006 (“the 2006 Regulations”) (S.I. 2006/1380).)

Welsh Government. 2012. Contaminated Land Statutory Guidance -2012. Welsh Government, [Document Number WGI5450](#).

### Project Reports:

Available from the Defra Project SPI008 [web page](#) and the British Geological Survey at: <http://www.bgs.ac.uk/gbase/NBCDefraProject.html>

Ander, E.L., Cave, M.R., Johnson, C.C. and Palumbo-Roe, B. 2011. Normal background concentrations of contaminants in the soils of England. Available data and data exploration. *British Geological Survey Commissioned Report, CR/11/145*. 124pp.

Ander, E.L., Cave, M.R. and Johnson, C.C. 2013. Normal background concentrations of contaminants in the soils of Wales. Exploratory data analysis and statistical methods. *British Geological Survey Commissioned Report, CR/12/107*.

Ander, E.L., Cave, M.R., Johnson, C.C. and Palumbo-Roe, B. 2012b. Normal background concentrations of contaminants in the soils of England. Results of the data exploration for Cu, Ni, Cd and Hg. *British Geological Survey Commissioned Report, CR/12/041*. 88pp.

Cave, M.R., Johnson, C.C., Ander, E.L. and Palumbo-Roe, B. 2012. Methodology for the determination of normal background contaminant concentrations in English soils. *British Geological Survey Commissioned Report, CR/12/003*. 56pp.

Johnson, C.C., Ander, E.L., Cave, M.R. and Palumbo-Roe, B. 2012. Normal Background Concentrations of contaminants in English soil: Final project report. *British Geological Survey Commissioned Report, CR/12/035*. 40pp.

Defra, 2012. Technical Guidance Sheet on normal levels of contaminants in English soils: Hg. Technical Guidance Sheet No. TGS07, July 2012. Department for Environment Food and Rural Affairs (Defra), Soils R&D Project SPI008. Available on-line from Defra project SPI008 [web page](#).

## ACKNOWLEDGEMENTS

The British Geological Survey has produced a series of Technical Guidance Sheets on NBCs for England as part of a project funded by Department for Environment Food and Rural Affairs (Defra) (Soils R&D Project SPI008, October 2011 – March 2012). The work was extended to apply the same methodology for determining NBCs in

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## BIBLIOGRAPHIC REFERENCE

When referring to this document the following bibliographic reference should be made:

Defra, 2013. Technical Guidance on normal levels of contaminants in Welsh soil: Hg: British Geological Survey (Keyworth, Nottingham) and Defra (London). R & D Project SP1008, January 2013. Available on-line from Defra project SP1008 [web page](#).

