Normal levels of contaminant concentrations in soils are referred to in the contaminated land Statutory Guidance for the Part 2A regime Defra 2012. This Technical Guidance Sheet (TGS) gives an indication as to what mercury concentrations can be expected in soils based on results from samples systematically collected across England. 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 Sheet, please refer to the section on 'Using Normal Background Concentrations' at the end, the Supplementary Information, and the revised Part 2A Statutory Guidance.

MERCURY (Hg)

Technical Guidance Sheet TGS07, July 2012.

Mercury (Hg) is a metallic element present in small quantities (0.02 mg/kg) in 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 ($HgCl_2$), and methylmercury (CH_3Hg). 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.

Domain	Area (km^2)	Area (%)	NBC (mg/kg)	n
Urban	5,400	4	**1.9**	512
Principal	127,500	96	**0.5**	1,126

Table 1: NBCs for the mercury domains (cited to 2 significant figures, n is number of samples used in the calculation). Mercury is determined by a variety of analytical methods on topsoils. The NBC is the upper 95% confidence limit of the 95th percentile of the domain data (see supplementary information).

NORMAL BACKGROUND CONCENTRATIONS (NBCs)

Methods

NBCs are calculated using contaminant data, with demonstrably high levels of quality assurance, for English topsoils systematically collected from a variety of land uses and analysed using certified methods. Unlike other inorganic element contaminants Hg has not been determined on the BGS G-BASE or NSI samples to an acceptable level of quality by XRFS. Instead, UK Soil and Herbage Pollutant Survey (Environment Agency), FOREGS, GEMAS and G-BASE urban samples for Stoke-on-Trent and London have been determined by cold vapour atomic absorption spectrometry (AAS) or Hg analyser. Additional, Hg results are taken from the Countryside Survey (Centre for Ecology and Hydrology, (CEH), several methods); and some from peer-reviewed publications (various methods) (see Figure 1).

Data exploration of all the Hg results would indicate urban areas have a distinctly higher level of Hg concentrations in topsoils than do rural areas. The variability in concentrations across England is shown in Figure 2 as a classified point symbol map. There are insufficient sample points for the whole of England to create an interpolated geochemical image.

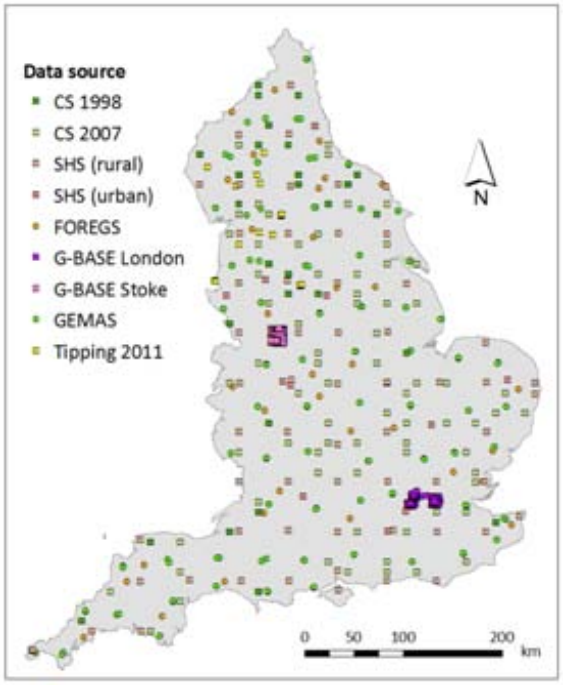

Figure 1: Map showing the distribution of samples used in the Hg NBC determination.

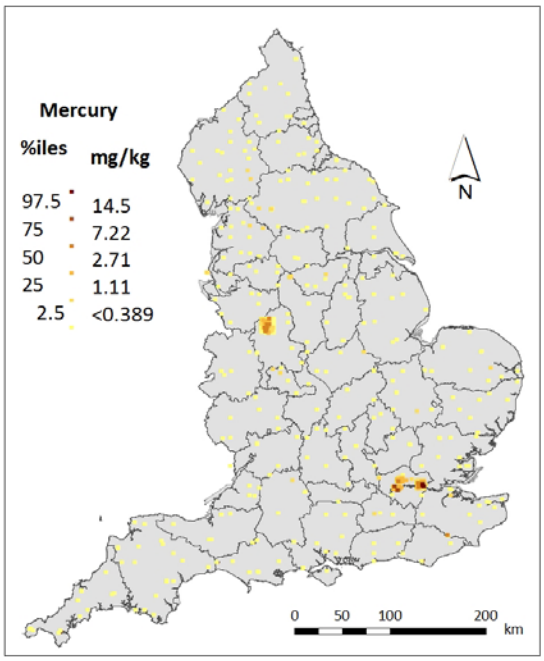

Figure 2: Map showing Hg in topsoil as a percentile classified symbol map.

Results for Hg in topsoils range from <0.01 – 30.8 mg/kg with the highest value and highest median (0.522 mg/kg) being recorded in the London area.

In order to establish meaningful NBCs, soils are grouped in domains, defined by the most significant controls on a contaminant's concentration and distribution. 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 contaminants are referred to in the Statutory Guidance (Sections 3.21-3.26 and 4.21(b)). They are represented here by the 95th percentile upper confidence interval, *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. Levels at or below the NBC may not be naturally occurring.

Results

Exploration of the soil data shows that the urban environment exerts a significant control on raising Hg concentrations in soil. From the small number of results from non-ferrous metalliferous mining areas there is no evidence to support the creation of a mineralisation domain.

Based on the limited number of results available a Principal and Urban Domain are defined (Figure 3 and Table 1).

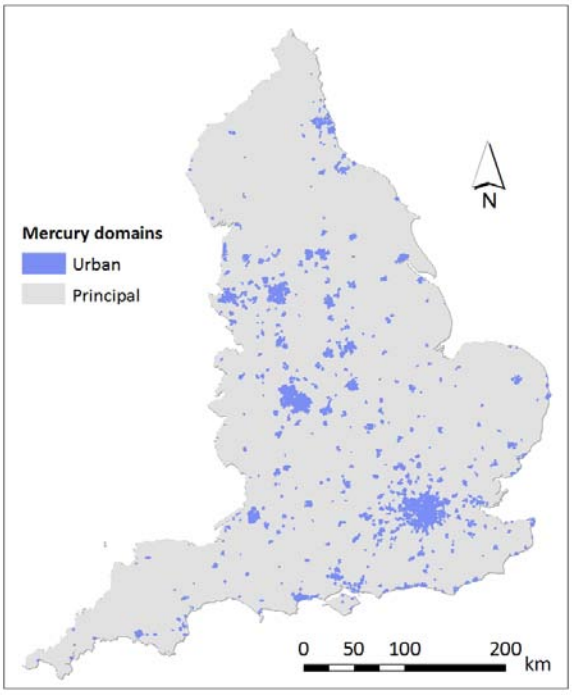

Figure 3: Mercury domain map

USING NORMAL BACKGROUND CONCENTRATIONS

The NBCs are produced to support the Part 2A contaminated land Statutory Guidance (SG) and help inform as to what are normal levels of contaminants. Using this TGS, 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 and the more detailed supplementary information provided with this guidance sheet. Additional on-line 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 TGS SHOULD BE READ IN CONJUNCTION WITH THE FOLLOWING:

Part 2 A documents:

Available from the Defra Contaminated land web site at:
http://www.defra.gov.uk/environment/quality/land/

Part 2A of the Environmental Protection Act 1990, as amended. The Contaminated Land (England) (Amendment) Regulations 2012 (Statutory Instrument 2012 No 263) (Amends Contaminated Land (England) Regulations 2006 ("the 2006 Regulations") (S.I. 2006/1380).)
Defra. 2012. Environmental Protection Act 1990: Part 2A. Contaminated Land Statutory Guidance. Department for Environment, Food and Rural Affairs. April 2012

Project Reports:
Available from the Defra Project SP1008 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.

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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.

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The accompanying supplementary information for the Mercury Technical Guidance Sheet:

Defra, 2012. Technical Guidance Sheet on normal levels of contaminants in English soils: Mercury – supplementary information. Technical Guidance Sheet No. TGS07s, July 2012. Department for Environment Food and Rural Affairs (Defra), Soils R&D Project SP1008. Available on-line from Defra project SP1008 web page.

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