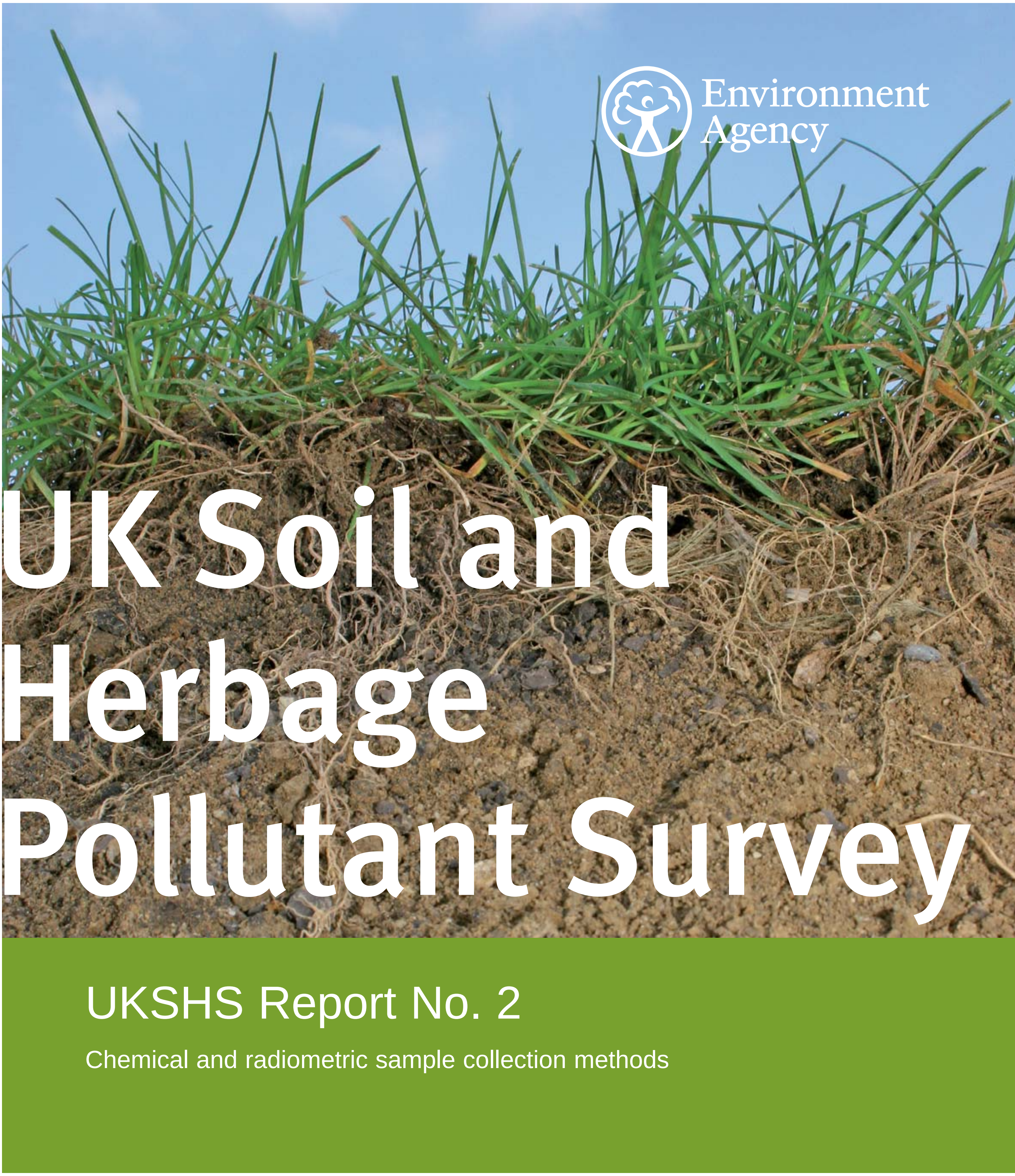

Environment Agency

UK Soil and Herbage Pollutant Survey

UKSHS Report No. 2

Chemical and radiometric sample collection methods

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This report is the result of research commissioned and funded by the Environment Agency's Science Programme.

Published by:
Environment Agency, Rio House, Waterside Drive,
Aztec West, Almondsbury, Bristol, BS32 4UD
Tel: 01454 624400 Fax: 01454 624409
www.environment-agency.gov.uk

ISBN: 978-1-84432-767-6

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or by telephoning 08708 506506.

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Dissemination Status:
Publicly available / released to all regions

Keywords:
soil, herbage, pollutant, polychlorinated biphenyls, dioxins, survey, polyaromatic hydrocarbons

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Science Project Number:
SC000027

Product Code:
SCHO0607BMSV-E-P

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- **Managing science**, by ensuring that our programmes and projects are fit for purpose and executed according to international scientific standards;
- **Carrying out science**, by undertaking research – either by contracting it out to research organisations and consultancies or by doing it ourselves;
- **Delivering information, advice, tools and techniques**, by making appropriate products available to our policy and operations staff.

Steve Killeen

Head of Science

Executive Summary

This report describes the soil and vegetation sampling protocols utilised within the UK Soil and Herbage Survey (UKSHS). The protocols described in this report are:

- selection of sampling sites and layout of sample collection areas;
- collection of soil samples for chemical analysis;
- collection of vegetation samples for chemical analysis;
- collection of soil samples for soil property analysis;
- collection of soil samples for radiometric analysis;
- collection of vegetation samples for radiometric analysis.

All sample collection protocols were accredited by the United Kingdom Accreditation Service (UKAS) to ISO17025[1] and all methods were peer reviewed by members of the UK Soil and Herbage Survey Project Board and external peer reviewers.

Contents

Glossary of terms

Air kerma	Kinetic energy of electrons released per unit mass of air by photon radiation. It is numerically very close to air dose.
Base position	South west corner of a northerly orientated 20 m x 20m sampling area from which GPS readings and triangulation bearings were taken.
Effective stack height	The effective stack height is equal to the physical stack height plus the plume rise.
Gray (Gy)	Unit of energy absorption from any type of ionising radiation by any type of medium. When the medium is tissue, it is a unit of dose. When the medium is air, it is a unit of exposure. 1 gray (Gy) = 100 rads.
Industrial	A site dominated by some form of industry.
Kerma	Kinetic Energy Released in Materials. Kerma is the sum of the initial kinetic energies of all the charged particles liberated by uncharged ionizing radiation (neutrons and photons) in a sample of matter, divided by the mass of the sample. Kerma is expressed in gray (or its submultiples), and, unless otherwise specified, it refers to the energy liberated per unit mass.
Rural	All other areas not categorised as industrial, urban, semi-urban or semi-rural. Predominantly agricultural land or undeveloped countryside.
Quadrat	A quadrat is a square area which defines the field of study. In the case of the UKSHS project a quadrat of size 50cm x 50cm was used as standard.
Semi-rural	Any area within a small town or village. A small town is taken as being 3–20 km^2 in area and a village being < 3 km^2 in area.
Semi-urban	All areas that abut urban centres and/or are 25 per cent urbanised/built up. Normally up to 3 km outside the urban core. May also be known as the urban fringe.
Undisturbed site	Unploughed land which has not had chemicals (pesticides/herbicides) applied to it. May include common land, meadows, rough pasture, parkland and fields that are infrequently grazed (if at all). Avoids wooded areas where possible.
Urban	An area which is $\geq$90 per cent urbanised/built up. A conurbation may be formed when a large town and city merge. Urban areas include large towns (20–50 km^2 in area) and cities (> 50 km^2 in area).

1 Introduction

The UK Soil and Herbage Pollutant Survey (UKSHS) is a research project sponsored jointly by:

- Environment Agency
- Department for Environment, Food and Rural Affairs (Defra)
- National Assembly for Wales
- Food Standards Agency
- Food Standards Agency Scotland
- Scottish Environment Protection Agency (SEPA)
- Environment and Heritage Service (Northern Ireland)
- Scotland and Northern Ireland Forum for Environmental Research (SNIFFER).

Dr Peter Crook from the Environment Agency provided overall project management on behalf of the sponsors. A consortium led by the University of Liverpool's School of Biological Sciences was commissioned to undertake the work. The consortium consisted of the Environment Agency's National Laboratory Service (NLS), Nottingham Trent University, the University of Stirling and the University of Liverpool (UoL), with additional assistance being provided by Parkman Ltd and the Environmental Advice Centre (EAC) Ltd.

The project's primary objective was to establish a baseline for pollutant levels in soil and herbage in the UK. The UKSHS has involved the collection of soil and herbage samples for chemical and radiometric analysis from industrial, rural and urban sites throughout the UK. Full details of the number of samples/sites visited and sampling techniques used are given in UKSHS Report No. 1.

The scale of the UKSHS has resulted a wealth of methodological information and analytical data. This made the presentation of the whole study in one report unwieldy and a series of 11 stand-alone reports has therefore been prepared, which users can read individually or as a complete set. This report describes the sampling methods used for the UKSHS and is Report No. 2 in the series. Full details of the other reports in the series can be found on the CD-ROM included with UKSHS Report No. 1 or from the Environment Agency website (www.environment-agency.gov.uk).

The sampling methods presented in this report include those for collecting:
- soil and herbage samples for chemical analysis (Sections 3.2 and 3.3);
- soil samples for soil property analysis (Section 3.4);
- soil and herbage samples for radiometric analysis (Sections 3.5 and 3.6).

All sampling methods have been accredited by the United Kingdom Accreditation Service (UKAS) to ISO17025[2] .

The study involved a comparison with results from previous surveys (carried out across the whole or parts of the UK) to identify any trends in the data. An important consideration in selecting and developing the sampling methods used in the UKSHS was therefore to ensure that the methods were similar, or related in a defined way, to those methods used previously. However, this was not a limiting factor in the selection and development of methods, which were based on the most current scientific thinking. All UKSHS methods have been peer reviewed by other technical experts in each field (Appendix 1).

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[2] The University of Liverpool is a UKAS accredited testing laboratory (No. 2049). The opinions and interpretations expressed in this report are outside the scope of accreditation.

2 Aims and Objectives

The overall aims and objectives of the UKSHS are detailed in the introductory report (UKSHS Report No. 1). Each report in the series addresses one or more of these aims and objectives. This report addresses the specific aim of producing sampling protocols for the collection of soil and herbage samples. These protocols have been produced to achieve the following objectives:

- to provide protocols for the collection of soil and herbage samples for chemical analysis for both organic and inorganic compounds;

- to provide protocols for the collection of soil samples for soil property analysis;

- to provide protocols for the collection of soil and herbage samples for laboratory gamma ray spectrometry analysis.

3 Sampling protocols for the UKSHS

The protocols described in this section are:

- selection of sampling sites and layout of sample collection areas (Section 3.1);
- collection of soil samples for chemical analysis (Section 3.2);
- collection of vegetation samples for chemical analysis (Section 3.3);
- collection of soil samples for soil property analysis (Section 3.4);
- collection of soil samples for radiometric analysis (Section 3.5);
- collection of vegetation samples for radiometric analysis (Section 3.6).

3.1 Selection of sampling sites and layout of sample collection areas

Three main types of site were included within the UKSHS:

- rural sites
- urban sites
- industrial sites.

Further details on the three different site types and their reasons for inclusion are given in UKSHS Report No. 1. Although the site types are different, the general procedure used to select a suitable site and location to sample was a generic one. The basis of this approach is outlined in Section 3.1.1 together with some specific considerations related to each site type.

3.1.1 Selection of sampling sites

To ensure that the aims and objectives of the UKSHS (see Report No. 1) were addressed successfully, the selection of both the general site and the actual location from which each sample was collected was one of the most important components of the sampling phase of the project. No matter how accurately a sample is collected and analysed, the results will be of little value if it is collected from an inappropriate location. For this reason, there was a tiered approach to the selection of sampling sites. Information collated, decisions made and the reasons for those decisions were documented to produce an auditable series of justifications for the selection of each site and sample location.

The three tiers in the site selection process were:

1. The approximate grid reference for each rural site was determined from the intersection of the 50 km grid (see UKSHS Report No. 1 for further details). For industrial and urban sites, the Environment Agency (or the equivalent organisation for the region to be sampled) provided UoL with grid references or the names of locations to be sampled. A number of the original grid references provided by the Environment Agency from previous surveys were found to be in urban areas and not rural as had previously been the case. A flexible approach was therefore adopted during the site selection process.

2. UoL staff conducted an office-based assessment of the general land type around each grid reference using 1:25,000 Ordnance Survey (OS) maps. Landowners were contacted in locations that were potentially suitable for sampling. Through telephone interviews with landowners, the suitability of each candidate sampling location was investigated further to determine whether the site met key criteria. Factors considered included:

    - the presence of areas of undisturbed land;
    - the current or previous application of biocides or other chemicals to that land;
    - the presence of vegetation;
    - the type of vegetation;
    - the history of the site.

    'Site questionnaires' were used during these interviews to prompt the interviewer and to ensure that all necessary details were recorded appropriately. These questionnaires provided a 'hard copy' information resource, which was then used to log the site onto the UKSHS database. A copy of the rural site questionnaire is given in Appendix 2.

    Once seemingly appropriate sites had been identified, the landowner's written permission was obtained wherever possible (verbal permission was obtained where written permission could not easily be obtained) and a site information pack was compiled for the field team. This information pack provided details of site location, landowner permission, access details and landowner comments.

3. The field team visited each site based on the information contained within the site information packs. The field team was responsible for conducting a visual assessment of the site to confirm that it met the necessary selection criteria in terms of both the appropriateness of the site to the site classification that it was to be used for (rural, urban or industrial) and its suitability for sampling.

    The basic requirement imposed was that samples had to be collected within a maximum 1 km radius of the 50 km x 50 km grid intersection point for rural sites and within a 500 m radius of the grid reference for urban and industrial sites. This afforded the field team some flexibility in locating an area that was 'undisturbed', i.e. away from footpaths, road verges, roads without visual sign of disturbance, etc.

    If the site was acceptable, the field team undertook sampling as described in the following sections. If the site was unsuitable, the field team recorded the reasons why the site was unsuitable on the site information sheet (Appendix 3) and identified an alternative site to sample which was as near to the location of the original site as possible. Additional guidelines used during the work are provided in Appendix 4. These detail how teams identified suitable sites with increasing distance from the grid intersection.

This general approach was adopted for the identification of suitable sampling sites. Further details relating to each site type are given below.

Rural site selection

Rural locations were based on the intersections of a 50 km x 50 km grid covering England, Wales, Northern Ireland and Scotland (see UKSHS Report No. 1). Once grid intersections were identified, land use (urban, rural or agricultural) in the area surrounding the intersection was determined using 1:25,000 scale OS maps. If the grid intersection fell in a rural area, the site was considered further for use in the survey. If it fell in an urban or agricultural area, then the criteria outlined in Appendix 4 were followed.

For the chemical survey, rural areas could be any undisturbed area including woodlands. For the radiometric work, however, the presence of trees could influence the response of gamma radiation dose and *in situ* gamma spectrometry detectors. Consequently for areas including woodland, one set of chemical samples was collected in the woodland but there was no radiometric sampling. The sampling location was then relocated to the closest area available that fulfilled the requirements for radiometric sampling (i.e. at least 20 m from trees, walls or buildings). Radiometric samples and a second set of chemical samples were collected from this location.

Note: In practice it is unlikely to find truly undisturbed soils due to bioturbation and, in this context, ‘undisturbed’ means undisturbed by anthropogenic activities.

Urban site selection

Urban locations selected included common land areas, parks and public gardens – though it was necessary to determine whether chemicals had been applied in parks and public gardens. The criteria employed for the selection of urban sites included size of area, presence of industry, population size and knowledge of past pollution levels. The Environment Agency (or equivalent organisation) provided UoL with details of sites to be targeted for sampling. Wherever possible, urban sampling sites avoided woodland areas because of their potential to influence the deposition of contaminants.

Industrial site selection

The Environment Agency (or equivalent organisation) selected industrial sites to represent a range of industrial activities/processes and provided grid references to UoL. Local Environment Agency site inspectors, site operators and local landowners were contacted and the sampling discussed in relation to sampling points, land use and history.

The prevailing wind direction was identified and the sampling undertaken at four sites – one upwind and three downwind based on the prevailing wind direction. The downwind sites were located at distances of five, ten and fifteen times the effective stack height (5 He, 10 He and 15 He) of the main emissions stack at the industrial installation. The sites were also confined to an angular sector not exceeding 60° (Figure 3.1). Local variations, if required, were agreed with site inspectors, taking account of dispersion modelling where available and appropriate.

Wherever possible, industrial sampling sites avoided woodland areas because of their potential to influence the deposition of contaminants from the industrial process/activity under consideration. However, 'undisturbed' woodlands were sampled in preference to areas of agricultural land, which generally have a highly disturbed soil profile.

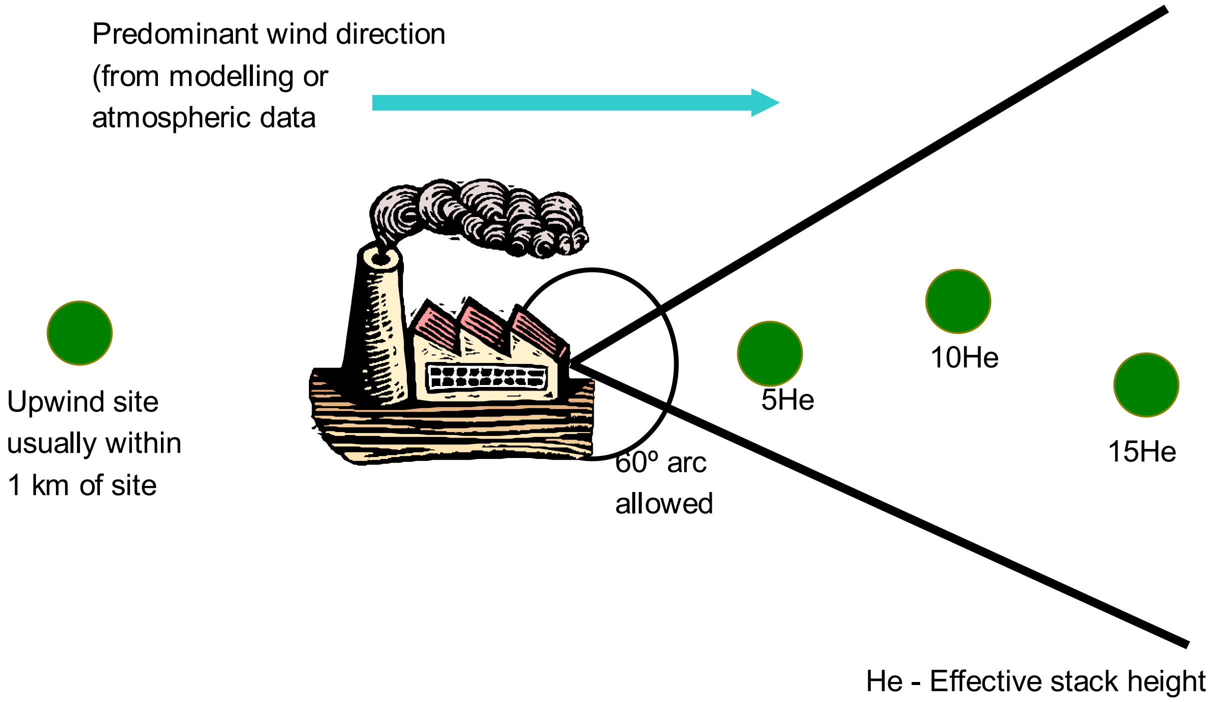


Figure 3.1 – Location of industrial sampling points around industrial site

3.1.2 Layout of sample collection areas

Rural and urban sites

For rural and urban sites, sampling focused on a 20 m x 20 m area (Figures 3.2 and 3.3). This 400 m^2 area was selected to reflect the local diversity of the vegetation and was used for measurement of gamma ray air kerma rates and *in situ* gamma spectrometry where required.

The only constraint was that radiometric work required an area at least 20 m away from any trees, walls or buildings because they can influence deposition of aerial contaminants and they affect the radiation field from the soil.

North was located with a compass and used to orientate the 20 m x 20 m area. A differential global positioning system (DGPS) reference (±5 m) and compass bearings were taken for the bottom left hand corner of the 20 m x 20 m area. This bottom left-hand corner was referred to as the base position. The following information was then recorded on the sample collection form (Appendix3):

- unique site location code;
- OS National Grid eight-figure reference (e.g. SX 362114 as taken from the OS maps);
- a DGPS reading (to 10 figures, e.g. SX 36251145) or triangulation bearings for the bottom left hand corner of the 20 m x 20 m sampling area (triangulation bearings were only taken if there was a problem with the DGPS, e.g. no signal or insufficient accuracy);
- oersonnel involved in the sampling;
- date, time and weather conditions;
- description of the site location;
- land use;
- proximity to industry (and its direction);

- site history (if is known or could be discovered by the field team);
- notes (freeform section for sample team notes about the site).

In addition, digital photographs were recorded at the site in order to demonstrate:

- the location of the sampling area;
- any bearings used for triangulation;
- weather conditions;
- the general appearance of the site.

Industrial sites

Industrial sites were sampled at points upwind and downwind of the industrial installation's main emissions stack. Each industrial site had four or more sampling points and, at each point, only one soil and one vegetation sample were collected. Consequently, the area at each sampling point from which the samples were collected was smaller than the 20 m x 20 m sampling area used for rural and urban sites. However, every effort was made to ensure that the sampling location met all the necessary criteria and that a representative vegetation sample was collected. The sampling area layout for each sampling point around an industrial site is given in Figures 3.4 and 3.5.

The DGPS readings (or triangulation bearings) for industrial sites were taken at the point from which the samples were collected rather than from a base position.

Note: for *in situ* gamma spectrometry calibration sites, an additional set of 40 cm cores should be taken at a distance of 8 m from the central point.

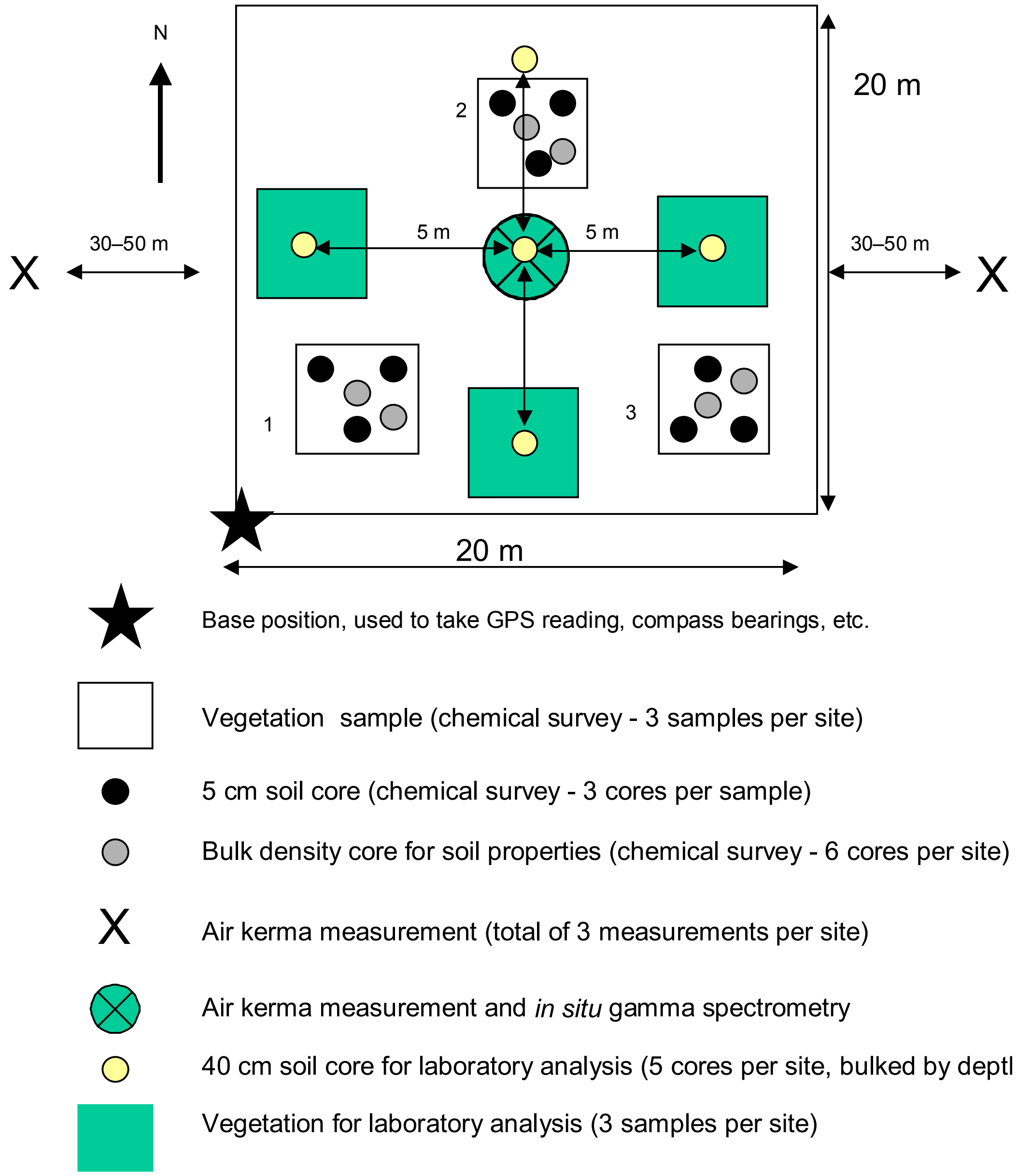


Figure 3.2 – Rural and urban site layout with radiometrics

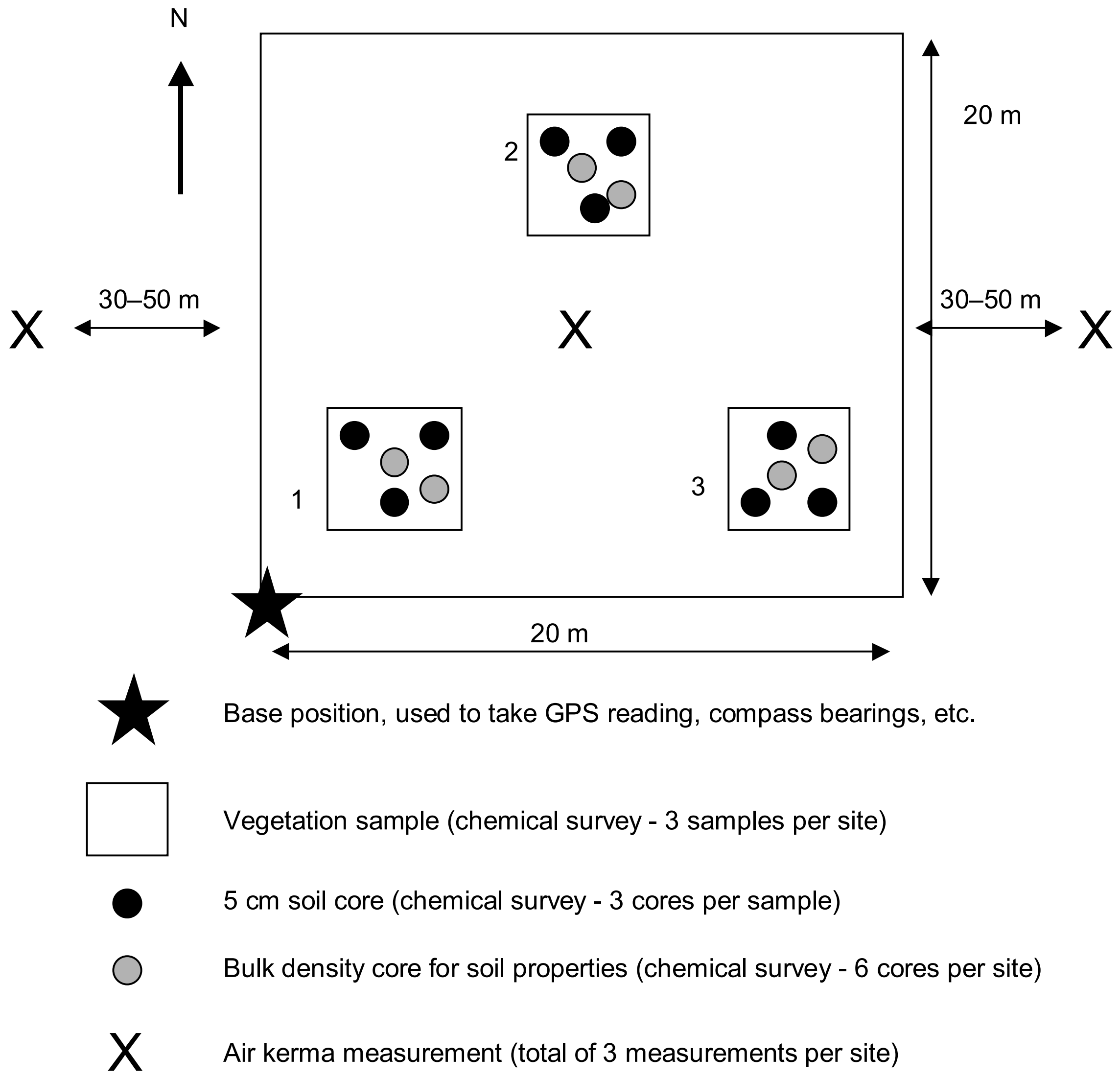
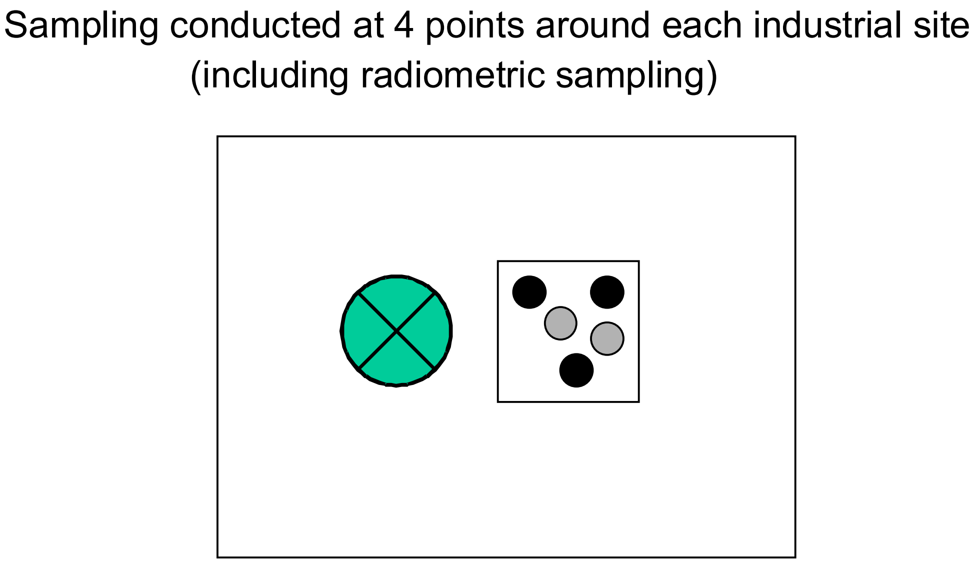


Figure 3.3 – Rural and urban site layout without radiometrics



⊗	Air kerma measurement (1 measurement per point) 1 × 40 cm soil core (for radiometric laboratory analysis) 1 × vegetation (for radiometric laboratory analysis) Collection of GPS reading, etc.
□	Vegetation sample (chemical survey - 1 sample per point)
●	5 cm soil core (chemical survey - 1 sample per point consisting of 3 soil cores)
○	Bulk density core for soil properties (2 cores per point)

Figure 3.4 – Industrial sampling point layout with radiometrics

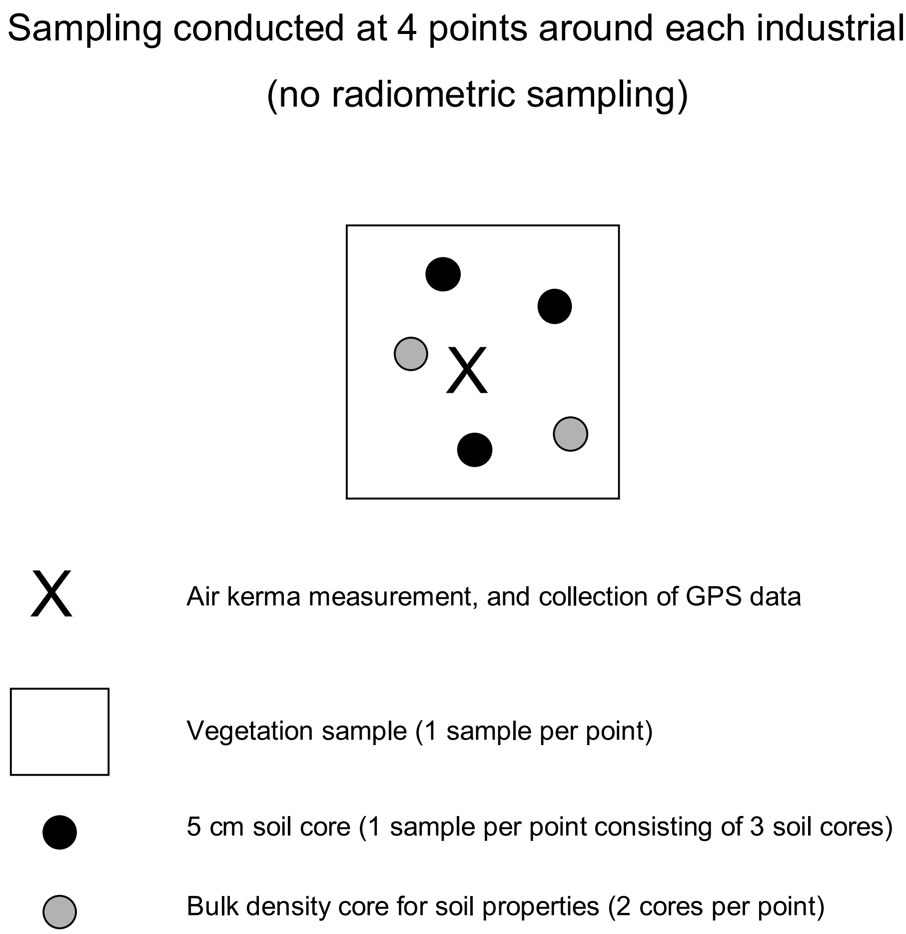


Figure 3.5 – Industrial sampling point layout without radiometrics

3.2 Collection of soil samples for chemical analysis

All soil samples for chemical analysis were collected using an Eijkelkamp coring kit. The corer had a stainless steel sample ring (53 mm diameter and 50 mm deep), which was locked within a stainless steel closed ring holder by the handle/beating head of the corer. The sample rings were seamless and smooth, both inside and out, such that the exact volume of soil sampled was known. The closed ring holder prevented water and/or soil entering the sample ring from above and removed the risk of the sample being lost from the top of the ring.

Three soil samples were collected for chemical analysis from each rural and urban site. The samples were composite samples made up of cores from each point taken to a depth of 50 mm using the bulk density corer. At each industrial point, one chemical soil sample was collected.

Before the soil cores were collected for chemical analysis, five cores were collected to a depth of 50 mm using the bulk density corer from a location immediately outside the 20 m x 20 m area. These cores were discarded away from the area. The purpose of this procedure was to ensure that the corer was ‘contaminated' by that site prior to use, thereby minimising the possibility of cross-contamination.

The soil cores were extracted from the same locations as those used for the vegetation sampling (see Section 3.3), i.e. in an inverted V shape within the 20 m x 20 m area (see also Figures 3.2–-

3.5). Three cores were extracted per vegetation sampling point and combined in a screw top 500 ml amber glass jar pre-washed with hexane (supplied by the NLS). Hexane-washed aluminium foil was placed under the screw cap and the jar then sealed with tape. Hexane-washed foil and sample containers were used to ensure that these items could not contaminate samples, thereby interfering with the analysis for organic compounds. The corer was wiped clean with tissue between sample collections.

When the soil corer came into contact with stones/rock before the required volume had been obtained, it was moved slightly to the side and the process repeated until a complete core was extracted. If, after three attempts, a full core could not be extracted from the same area due to stones, the soil stone content was assessed. A 30 cm x 30 cm x 5 cm (deep) pit was excavated with all the excavated soil deposited onto a plastic sheet so that the pit could be easily refilled on completion. The stone quantity in the profile was estimated visually for the percentage of mottles, stones or nodules present using a chart based on the *Soil Survey Field Handbook* (Hodgson 1974).

It was a requirement that the total mass of the soil cores collected should equate to 500 g wet weight (100 g dry weight). If the soil was stony or peaty, additional soil cores (6–8) were extracted from the other diagonal across the 20 m x 20 m area. The extra cores were bulked in a second, separately labelled, hexane-washed glass jar.

All samples were placed in site designated cool boxes (with ice packs) and transferred to the analytical laboratories (see Section 4). The soil samples for chemical analysis were prepared in accordance with the NLS methods.

3.3 Collection of vegetation samples for chemical analysis

All vegetation samples for chemical analysis were collected using gardening sheers. A variety of different makes of sheers were used during the course of the project, but all sheers had stainless steel blades that were hexane-washed before their first use.

Three vegetation samples were collected from each rural and urban site. Each industrial site had four or more sampling points and one vegetation sample was taken from each one.

Before sample collection and in order to ‘clean’ the shears, they were used to randomly cut vegetation outside the 20 m x 20 m area. The shears were wiped clean with tissue between sample collections. The 20 m x 20 m area was surveyed for vegetation coverage and species diversity. Using a quadrat (size 0.25 m x 0.25 m) to ensure that the area of vegetation sampled could be accurately recorded, three vegetation samples were collected in an inverted V shape (see Figures 3.2 and 3.3). Vegetation within the quadrat was clipped to 10–20 mm above the soil surface, avoiding worm casts and surface litter.

The collected vegetation was placed in a pre-labelled bags lined with hexane-washed aluminium foil. The quadrat was relocated adjacent to the area previously cut until sufficient material had been collected, i.e. between 500 and 1,000 g wet weight to ensure that at least 100 g dry weight would be available for analysis. This quadrat area was representative of vegetation cover and avoided areas of poor vegetation growth and shrubs/trees. Woody species were avoided when selecting a site for the quadrat. If this was not practical, only the leafy/green material was harvested and a note made on the site record sheet. Where the area was patchy and contained different species, the quadrat was placed over the interface of the species.

All samples were then placed in site-designated cool boxes (with ice packs) and transferred to the analytical laboratories.

3.4 Collection of soil samples for soil property analysis

Four soil properties were assessed for the UKSHS. These were:

- bulk density
- pH
- texture
- organic carbon/matter content.

Six soil cores were collected from each rural and urban site for soil property work. Two soil cores and one small bag of soil were collected from each point around an industrial site.

The sample collection procedure was the same as that used for the collection of soil samples, but the cores were wrapped individually in foil and then bagged.

3.5 Collection of soil samples for radiometric analysis

Natural and anthropogenic radionuclides that contribute to gamma dose rates emit gamma rays at energies ranging from a few tens of keV to several MeV. Below a soil depth of 400 mm, radionuclides with gamma energies <700 keV do not contribute to air kerma dose rates due to absorption of gamma rays in the soil. Therefore, only radionuclide concentrations within the top 400 mm of the soil column make significant contributions to measured gamma dose rates.

Many of the natural radionuclides are evenly distributed throughout the soil column, but anthropogenic radionuclides such as ^{137}Cs deposited from the atmosphere onto undisturbed soils are unevenly distributed throughout the soil column (Copplestone *et al*. 2000). Analysis of individual sections from 400 mm soil cores by laboratory-based gamma spectrometry allows the radionuclide distribution throughout the soil profile to be determined. This information can be used to predict the total contribution to air kerma dose rates.

Soil samples were collected after gamma air kerma dose rate measurments and, where required, *in situ* gamma spectrometry measurements. Four cores were collected from the end-points of an X, centred on the detector (see Figure 3.6), with each arm of the X measuring 5 m from the detector. One core was collected from directly under the detector, giving a total of five cores. Ten site locations, selected as representing different soil types and underlying geologies, were used as calibration sites for the *in situ* gamma spectrometry. At these sites an additional 4 cores were taken at a distance of 8 m from the central point where the detector was located and sited as shown in Figure 3.6.

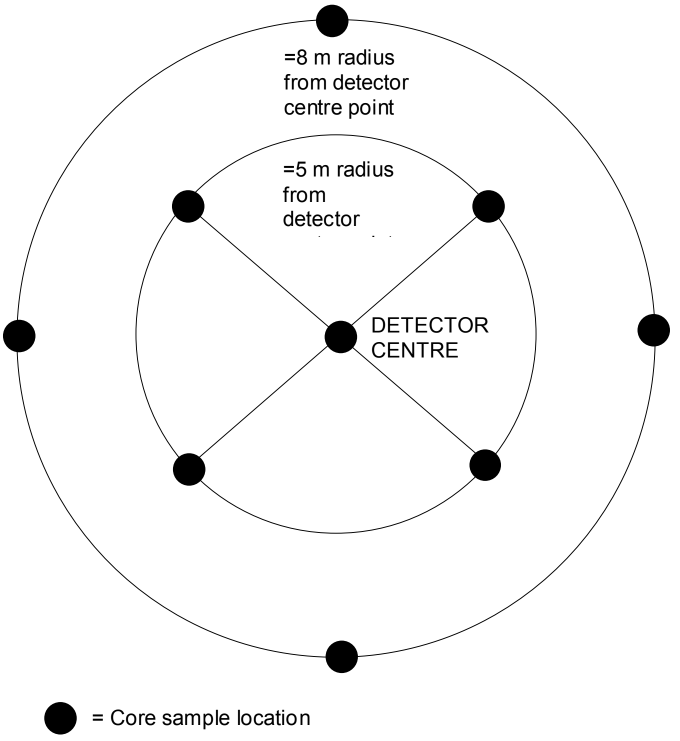


Figure 3.6 – Soil core locations in relation to the detector

Prior to coring, overlaying vegetation was cut and leaf litter/stones were removed by gently scraping the surface with a penknife, thus exposing the top surface of the soil. A soil core was collected using a stainless steel corer (100 mm diameter x 500 mm height). A rubber-headed mallet was used to hammer the corer to 400 mm. The corer was then rotated to free the base of the core and purpose-built lifting tackle was employed to remove the corer, complete with 400 mm soil core, from the ground. The core was released from the corer and any remaining vegetative material on the core was removed.

if the soil corer hit stones/rock before the whole volume of the corer was filled, the corer was moved slightly to the side and the process repeated until a complete core was extracted. If after three attempts a full core could not be extracted from the same area due to stones, an assessment of soil stone content was made as described in Section 3.2 – but this time the assessment was made to a depth of 300 mm.

The soil corer was wiped with a paper towel between extractions and washed thoroughly between sample locations. The coring process was repeated until all the cores had been collected from the site location.

Each core was sectioned into 0–50, 50–100, 100–150, 150–200, 200–300 and 300–400 mm slices using a sharp knife and a 500 mm ruler graduated to 1 mm. The knife was washed between each section to minimise cross-contamination.

A core was extracted from the centre of each slice using a stainless steel metal cutting ring. The outer edge of the original core was discarded (to eliminate the potential for smearing along the length of the core) and the cutter was washed between sections to minimise cross-contamination.

Each core slice was then combined with the equivalent slices from the other cores (except for the *in situ* calibration sites where every slice was to be analysed separately). This produced six samples for gamma spectrometry analysis per site (54 for calibration sites). The samples were double-bagged in plastic bags and placed in cool boxes for transport back to the laboratory.

3.6 Collection of vegetation samples for radiometric analysis

Three vegetation samples per site were collected at rural and urban locations, and one vegetation sample from each industrial sampling point.

Vegetation samples were collected after gamma ray air kerma rates and any *in situ* gamma spectrometry measurements were taken. The sampling procedure was the same as that used to collect vegetation samples for chemical analysis. The samples were double-bagged in plastic bags and placed in cool boxes for transport back to the laboratory.

4 Sample transport and maintenance

All sample containers for the chemical survey were supplied by the NLS to UoL in advance of sampling. These sample containers were used for transporting the samples between the field and laboratories.

All samples collected from one particular site location were stored in a site-designated cool box, along with ice packs to prevent sample deterioration during transit, and the boxes sealed with tape for transfer to the UoL laboratory.

On arrival at the UoL laboratory, samples were logged using the UoL sample tracking system and the integrity of the samples checked.

The chemical survey samples were stored as follows:

- soil samples in a refrigerator/cold room at <4°C;
- vegetation samples placed into a freezer at <20°C.

For the radiometric survey, both soil and vegetation samples were stored in a freezer at <20°C in accordance with the sample storage procedures used in the UoL laboratory.

5 Sample archive

Samples from the chemical survey are to be stored by the NLS for a period of 10 years and samples from the radiometric survey are to be stored by UoL for a period of 10 years.

List of abbreviations and acronyms

DGPS	differential global positioning system
GPS	global positioning system
He	effective stack height
OS	Ordnance Survey
NLS	National Laboratory Service
UKAS	United Kingdom Accreditation Service
UKSHS	UK Soil and Herbage Pollutant Survey
UoL	University of Liverpool

References

Copplestone D, Johnson M S, Jones S R and Jackson D, 2000 *Doses to biota in the vicinity of BNFL Sellafield, Cumbria, UK*. Radiation Protection Dosimetry, **92**, No. 1–3, 177–182.

Hodgson J M, 1974 *Soil Survey Field Handbook: describing and sampling soil profiles*. Soil Survey Technical Monograph No. 5. Harpenden: Rothamsted Experimental Station.

Appendix 1: External peer review

The methods for the UK Soil and Herbage Pollutant Survey were developed and modified through a consultative process with further refinement through peer review.

Internal peer review

The internal peer reviewers were:

- Dr Paul Dale, Scottish Environment Protection Agency
- Dr Rob Allott, Environment Agency
- Dr Jane Rowe, Environment Agency.

External peer review

The external peer reviewers were:

- Professor P J Loveland, PhD, Professor of Applied Soil Chemistry, Soil Survey and Land Research Centre, Cranfield University

- Dr Bernie T Wilkins, Environmental Assessments Department, National Radiological Protection Board.

Copies of the letters from Professor Loveland and Dr Wilkins are available on request.

Appendix 2: Rural site questionnaire

1. Site number		Site type	RURAL
2. a) Environment Agency Area Office			
2. b) AREA OFFICE CONTACT NAME.			
3. Site grid reference (provided by Environment Agency)			

4. CONTACT NAME AND DETAILS FOR THE SITE (Please note some urban sites may be recreational parks owned by local authorities – please provide a name or department if possible.)	Name Position Address Phone
5. LAND USE What is the land use, e.g. common land, parkland, etc. What is the site category? (See guidelines and definitions for site selection.) Details of any site disturbance, e.g. have biocides been applied to the area, do animals graze the area?	If the site is considered to be disturbed, please complete section 8. An **undisturbed site** being grassland, avoiding wooded areas where possible. This may include common land, meadows, parkland and fields that are infrequently grazed, if at all.

6. SITE HISTORY Details of previous land use over the past 10 years? Has there been a major change in land use? Has previous land use disturbed the site?	If the site is considered to be disturbed as a result of previous use, please complete section 8.
7. PROXIMITY TO POLLUTION SOURCES What industries or other potential sources of pollution, such as crematorium or hospital incinerator, are located within 2 km of the site? And in what direction (with respect to the prevailing wind)?	If the site is considered too close to industry, please complete section 8.
8. ALTERNATIVE GRID REFERENCES If the site is considered 'disturbed' or in the vicinity of industry, please suggest alternative grid references in the proximity of the original site. What is the site category of the proposed grid reference/s? (See guidelines and definitions for site selection.)	Please refer to 'guidelines for site selection' and 'definitions used in the site selection process' for assistance in completing this section.
9. ADDITIONAL NOTES	

Appendix 3: Proforma for recording site information

Collected by:		
Team:	In situ Chemical	
Time and date:		
Site: e.g. Wales/Urban		
ERC Site Code:		
Chemical soil –1 (TAG) **Chemical soil –2 (TAG)** **Chemical soil –3 (TAG)**		
Chemical veg –1 (TAG) **Chemical veg –2 (TAG)** **Chemical veg –3 (TAG)**		
Number of veg quadrats Size of quadrats	Sample 1- Sample 2- Sample 3-	
Bulk density –1 **Bulk density –2** **Bulk density –3**		
Bag of soil for soil texture?	Only required from industrial sites. Label with ERC Site Code and sampling point number.	
Extra chemical samples?		
Duplicate samples?		
GPS reading (± 5 m)		
Triangulation **Bearing 1** **Bearing 2** **Bearing 3**	**Magnetic Bearing**	**Reference Point**
Weather (circle)	Shower Drizzle Light rain Heavy rain Downburst Hail Snow Clear Partly cloudy Broken clouds Cloudy Partly sunny Overcast	
Ground condition (circle)	Frozen Damp Sodden Standing water Moist to touch Dry Hexagonal cracking	
Soil type		
Site description including current land use.		

Vegetation cover (% by eye) **Bare soil (% by eye)**	
Stone content	
Site photos (camera number, photo number and description)	

RADIOMETRIC SAMPLES

Air kerma probe serial number	
Air kerma counts Counted for 600 seconds unless stated otherwise.	1- 2- 3-

VEGETATION LABELS	**Label the bag and then double bag the sample.**
Sample 1	RV
Sample 2	RV
Sample 3	RV

CORE PHOTOS

SOIL CORE LABELS	**Label the bag and then double bag the sample.**
0–5 cm	RS
5–10 cm	RS
10–15 cm	RS
15–20 cm	RS
20–30 cm	RS
30–40 cm	RS

Landowner and contact details (if previously unavailable)	
Problems Identified	
Notes	

Appendix 4: Guidelines for site selection

1) Are you looking for a rural site?
   Yes Go to question 4.
   No Go to question 2.
2) Are you looking for an urban site?
   Yes Go to question 11.
   No Go to question 3.
3) Are you looking for an industrial site?
   Yes Go to question 13.
   No Go to question 1.
4) Does your site seem to be in a rural area according to the definition?
   Yes Go to question 5.
   No Go to question 2.
5) Is your site within 100 m of a densely wooded area?
   Yes Move site so it is 100 m away from the wooded area. Go to question 6.
   No Go to question 6.
6) Is your site within 10 m of a B-road or smaller?
   Yes Move site so it is 10 m away. Go to question 7.
   No Go to question 7.
7) Is your site within 500 m of an A-road or railway line?
   Yes Move site so it is 500 m away. Go to question 8.
   No Go to question 8.
8) Is your site within 1 km of an incinerator or similar point source?
   Yes Move site so it is 1 km away. Go to question 9.
   No Go to question 9.
9) Is your site surrounded by fields/open land?
   Yes Rural site, R_1
   No Go to question 10.
10) Is your site in or on the edge of a village?
    Yes Move site so it is 100 m away from the built up area. Semi-rural site, R_2
    No Go to question 11.
11) Is your site in or on the edge of a small town?
    Yes Move site so it is 100 m away from the built up area. Semi-rural site, R_3
    No Go to question 12.
12) Is your site in a large town or city?
    Yes Move site so it is 50 m away from housing or trees (for dose meter reading). Urban site
    No Go to question 13.
13) Is your site on the edge or a large town or city?
    Yes Move site so it is 100 m away from the built up area. Semi-urban site
    No Go to question 14.
14) Is your site in an industrialised area?
    Yes Move site so it is 50 m away from any buildings. Industrial site
    No Go to question 4.

We are The Environment Agency. It's our job to look after your environment and make it **a better place** – for you, and for future generations.

Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

The Environment Agency. Out there, making your environment a better place.

Published by:

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