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NATURAL ENVIRONMENT RESEARCH COUNCIL



User Guide for the HPA-BGS Joint Radon Potential Dataset for Great Britain

Open Report IR/11/044

BRITISH GEOLOGICAL SURVEY

OPEN REPORT IR/11/044

User Guide for the HPA-BGS Joint Radon Potential Dataset for Great Britain

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BRITISH GEOLOGICAL SURVEY

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Foreword

This report presents a description and review of the methodology developed by the British Geological Survey (BGS) and the Health Protection Agency (HPA) to produce a digital radon potential dataset for Great Britain. The method has been critically assessed and its fitness for purpose determined by J D Appleton, C Scheib and K A M Adlam (BGS) and N P McColl (HPA).

Contents

Foreword	i
Contents	ii
Summary	iv
Acknowledgements	iv
1 Introduction	5
2 About the Radon Potential Dataset for Great Britain	5
2.1 Background.....	5
2.2 Who might require this data?.....	6
2.3 What the dataset shows?.....	7
3 Technical Information	8
3.1 Definitions	8
3.2 Scale.....	8
3.3 Field descriptions.....	8
3.4 Creation of the dataset	9
3.5 Use of OS Addresspoint to search the radon potential dataset for small buildings in Great Britain.....	12
3.6 Searching the radon potential dataset for large buildings or sites in Great Britain.....	12
3.7 Dataset history	13
3.8 Coverage.....	13
3.9 Data format.....	13
3.10 Limitations	14
4 Model Questions and Answers	15
4.1 Radon Affected Area	15
4.2 Radon Protective Measures	16
5 Further Information	18
5.1 Risks of radon.....	18
5.2 Action Level for radon	18
5.3 Radon Affected Areas	18
5.4 How to reduce radon levels	18
5.5 Radon in the workplace	18
6 Contacts	19
7 Licensing Information	19
8 References	20

FIGURES

Figure 1 Extract from RADON POTENTIAL DATASET FOR GREAT BRITAIN (Left) and corresponding INDICATIVE ATLAS OF RADON IN GREAT BRITAIN DATASET (Right).....	10
Figure 2 Indicative Atlas of Radon in Great Britain	11

TABLES

Table 1 Attribute table field descriptions for RADON POTENTIAL DATASET FOR GREAT BRITAIN (Radon_gb_v2).....	8
Table 2 Attribute table field descriptions for INDICATIVE ATLAS OF RADON IN GREAT BRITAIN DATASET (Radon_gb_atlas_v2)	8
Table 3 Radon Potential Classes and percentage bands.....	9

Summary

This report presents a description and review of the methodology developed by the British Geological Survey (BGS) and the Health Protection Agency (HPA) to produce an assessment of radon potential in Great Britain. The methodology is briefly described in this report and in scientific papers. The purpose of the user guide is to enable those licensing this dataset to have a better appreciation of how the dataset has been created and therefore better understand the potential applications and limitations that the dataset may have.

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Kate Royse, Gerry Wildman, Matt Harrison, Malcolm Brown, Keith Westhead (BGS), and Neil McColl (HPA) are thanked for reviewing and suggesting improvements to this report.

1 Introduction

Founded in 1835, the British Geological Survey (BGS) is the world's oldest national geological survey and the United Kingdom's premier centre for earth science information and expertise. The BGS provides expert services and impartial advice in all areas of geoscience. Our client base is drawn from the public and private sectors both in the UK and internationally.

BGS's innovative digital data products aim to help describe the ground surface and what is beneath the whole of Great Britain. These digital products are based on the outputs of the BGS survey and research programmes and our substantial national data holdings. This data coupled with our in-house geoscientific knowledge are combined to provide products relevant to a wide range of users in central and local government, insurance and housing industry, engineering and environmental business, and the British public.

Further information on all the digital data provided by the BGS can be found on our website at <http://www.bgs.ac.uk/products/home.html> or by contacting: Central Enquiries, British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham, NG12 5GG; Direct tel. +44(0)115 936 3143; Fax. +44(0)115 9363150 ; email enquiries@bgs.ac.uk

The Radiation Protection Division (RPD) was formed in 2005 when the National Radiological Protection Board merged with the Health Protection Agency (HPA) under the provisions of the Health Protection Agency Act 2004. As part of the Centre for Radiation, Chemical and Environmental Hazards, the RPD carries out the Agency's work on ionising and non-ionising radiations. It undertakes research to advance knowledge about protection of people from the risks of these radiations; provide laboratory and technical services; runs training courses; provides expert information and has a significant advisory role in the UK.

For further general information on radon contact: Radon Survey, Health Protection Agency Centre for Radiation, Chemical and Environmental Hazards, Chilton, Didcot, Oxon OX11 0RQ Direct tel. +44(0) 1235 822622; Fax. +44(0) 1235 833891; Email: radon@hpa.org.uk; Web: www.hpa.org.uk

The Radon Potential Dataset for Great Britain was produced as the result of collaboration between the BGS and the HPA.

2 About the Radon Potential Dataset for Great Britain

2.1 BACKGROUND

Public understanding of the effect of land contamination and ground conditions on the health of the occupants, the safety of property, and the implication for the value of property is growing. Local councils are under increasing pressure from central government to provide environmental information. Information about geological and geochemical hazards is needed, in particular, the identification of areas with a potential for land contamination or ground movement.

In response to this, BGS initiated a development programme to produce data sets that identified and assessed potential geohazards threatening the human environment in Great Britain. Since 2000, the programme has generated:

- Six ground stability hazard datasets
- Superficial deposit thickness models
- Scans of onshore borehole logs for Great Britain
- Scans of geology and historic topography maps
- Ground permeability data
- Susceptibility to groundwater flooding data
- Geological indicators of past flooding data
- **GIS data identifying potential radon hazard (produced in collaboration with the HPA)**Non-coal mining hazards data

Radon is a natural radioactive gas, which enters buildings from the ground. Exposure to high concentrations increases the risk of lung cancer. Radon is the biggest source of human exposure to ionising radiation in the UK and is responsible for an estimated 1,100 lung cancer deaths a year (McCull et al., 2010). The Health Protection Agency recommends that radon levels should be reduced in homes where the annual average is at or above 200 becquerels per cubic metre (200 Bq m⁻³). This is termed the Action Level. The Health Protection Agency defines radon Affected Areas as those with 1% chance or more of a house having a radon concentration at or above the Action Level of 200 Bq m⁻³.

After reviewing the latest scientific evidence, as well as the costs and benefits of radon reduction measures, the HPA retained its Action Level of 200 becquerels per cubic metre (Bq m⁻³) – but introduced a new Target Level of 100 Bq m⁻³. The Target Level was introduced because research published since 1990 has given scientists a greater understanding of the risks to health of exposure to radon below 200 Bq m⁻³ and because HPA now has considerably more experience of the effectiveness of remediation measures. Although low level exposures can still lead to lung cancer, the risks at these levels are low and can be reduced further by simple mitigation measures designed to increase underfloor ventilation.

The HPA recommends that parts of the country with less than a 1% chance of exceeding the Action Level will now be referred to as Lower probability areas; the terms Intermediate and Higher probability will be applied to areas with 1 – 10% chance and at least a 10% chance of exceeding the Action Level. The HPA recommends that householders in intermediate and higher probability radon areas should have measurements made of indoor radon concentration in their home (McCull et al., 2010).

The HPA recommends that Target and Action Levels should be applied to other premises where occupancy by members of the public exceeds 2,000 hours per year and to all schools.

The joint HPA-BGS digital RADON POTENTIAL DATASET FOR GREAT BRITAIN provides the current definitive map of radon Affected Areas in Great Britain.

A summary of the relationship between radon and geology in Wales is available in Appleton and Miles (2005) and for Scotland in Scheib et al. (2009).

2.2 WHO MIGHT REQUIRE THIS DATA?

- Local Authority Environmental Health and Building Control Departments
- Organisations providing environmental reports for property owners and developers
- Solicitors, environmental and radiological consultants

2.3 WHAT THE DATASET SHOWS?

The RADON POTENTIAL DATASET FOR GREAT BRITAIN will also allow an estimate to be made of the probability that an individual property in Great Britain is at or above the Action Level for radon. The data can also be used to provide a radon potential estimate for a development site.

The data can be used to:

1. provide the answer to one of the standard legal enquiries on house purchase in England and Wales, known as CON29 Standard Enquiry of Local Authority; 3.13 Radon Gas: Location of the Property in a radon Affected Area. The data can also be used to advise house buyers and sellers in Scotland.
2. provide information on the level of protection required for new buildings under BR211 (Scivyer, 2007) *Radon: Guidance on protective measures for new buildings* and BR376 (BRE, 1999) *Radon: Guidance on protective measures for new dwellings in Scotland*.

For CON29 enquiries in England and Wales, the full address and postcode or the National Grid coordinates of a property will be required to interrogate the RADON POTENTIAL DATASET which will provide an estimate of the probability that a particular property is at or above the Action Level for radon. For BR211 and BR376 enquiries, the dataset can also be searched using site outlines when no property addresses are available. More information on how address data can be used to interrogate the Radon Potential dataset is described in sections 3.5 and 3.6.

Searches of the full dataset are available by postcode from www.UKradon.org or by site area from the BGS enquiries service (Direct tel. +44(0)115 936 3143; Fax. +44(0)115 9363150; email enquiries@bgs.ac.uk).

3 Technical Information

The Joint Radon Potential Dataset for Great Britain is split into two layers:

1. RADON POTENTIAL DATASET FOR GREAT BRITAIN
2. INDICATIVE ATLAS OF RADON IN GREAT BRITAIN

3.1 DEFINITIONS

- RADON POTENTIAL DATASET FOR GREAT BRITAIN (Radon_gb_v2) provides the current definitive map of radon Affected Areas in Great Britain.
- INDICATIVE ATLAS OF RADON IN GREAT BRITAIN DATASET (Radon_gb_atlas_v2) presents a simplified version of the RADON POTENTIAL DATASET FOR GREAT BRITAIN with each 1-km grid square being classed according to the highest radon potential found within it, so it is indicative rather than definitive. The INDICATIVE ATLAS OF RADON IN GREAT BRITAIN is published in two documents for England and Wales (Miles et al., 2007) and Scotland (Miles et al., 2011)

3.2 SCALE

The RADON POTENTIAL DATASET FOR GREAT BRITAIN is produced for use at 1:50 000 scale.

3.3 FIELD DESCRIPTIONS

Table 1 Attribute table field descriptions for RADON POTENTIAL DATASET FOR GREAT BRITAIN (Radon_gb_v2)

FIELD NAME	FIELD TYPE	DESCRIPTION	FIELD CONTENT
CLASS	Numeric-integer	Radon potential class	Range: 1 to 6*
Version	String	Dataset title and version number	Radon_GB_V2

Table 2 Attribute table field descriptions for INDICATIVE ATLAS OF RADON IN GREAT BRITAIN DATASET (Radon_gb_atlas_v2)

FIELD NAME	FIELD TYPE	DESCRIPTION	FIELD CONTENT
Tile	String	Ordnance Survey 1-km grid square identifier	e.g. NUO547
Class_max	Numeric-integer	Radon potential class	Range: 1 to 6*
Version	String	Dataset title and version number	Radon_GB_Atlas_V2

* See Table 3 for explanation of Class percentage bands

Table 3 Radon Potential Classes and percentage bands

Radon Potential Class	Estimated percentage of dwellings exceeding the Radon Action Level (Nominal percentage band)	Estimated percentage of dwellings exceeding the Radon Action Level (Actual percentage band)
1	0-1	0 to 0.99999
2	1-3	1 to 2.99999
3	3-5	3 to 4.99999
4	5-10	5 to 9.99999
5	10-30	10 to 29.99999
6	30-100	30 to 100

3.4 CREATION OF THE DATASET

Previously, the potential for high radon levels in UK houses has been mapped either on the basis of grouping the results of radon measurements in houses by grid squares or by geological units. In both cases, lognormal modelling of the distribution of radon concentrations was applied to allow the estimated proportion of houses at or above the UK radon Action Level (AL, 200 Bq m⁻³) to be mapped. Combining the grid square and geological mapping methods gives a more accurate map than either method can provide separately (Miles and Appleton, 2003, 2005, 2007).

The land area is first divided up using a combination of bedrock and superficial geological characteristics derived from BGS DiGMapGB-50 (1: 50 000 scale) digital geological map data. Each different combination of geological characteristics may appear at the land surface in many discontinuous locations across the country. The Health Protection Agency has a database of over 479 000 houses in which long-term measurements of radon concentration have been made, and whose locations are accurately known. Each of these measurements is allocated to the appropriate bedrock–superficial geological combination underlying it. Taking each geological combination in turn, the spatial variation of radon potential is mapped, treating the combination as if it were continuous over the land area. All of the maps of radon potential within different geological combinations are then combined to produce a map of variation in radon potential over the whole land surface. This unbuffered dataset formed the raw data on which processing was carried out to ensure all end-users would achieve consistent results.

The unbuffered radon potential dataset was pre-processed using ArcGIS 9.3.1 :

- To include a 'geological data accuracy' buffer of 50 m to allow for the precision (uncertainty) of the geological lines as defined as part of the 1:50,000 scale DiGMapGB-50 product used to create the raw radon dataset.
- To include a 'residential property' buffer of 25 m, to allow for the average extent of homes located using Ordnance Survey ADDRESS-POINT® coordinates.

The 'geological data accuracy' and 'residential property' buffers were added together and the resultant 75-m buffer was applied sequentially to radon potential Class 6, 5, 4, 3 and 2 (Table 3) base radon potential data polygons derived from unbuffered radon potential data. These buffered polygons, together with the Class 1 polygons, were converted to separate 25-m raster grids,

which were then superimposed¹ on each other to produce a final 25-m raster grid that gives the highest Class for each individual 25-m cell.

The radon potential dataset based on DiGMapGB-50 does not quite extend to the coastline in some areas; either because reclamation of land has moved the coastline or because the coastline used on the paper map from which the digital geology was captured does not quite reach the actual coastline due to the scale of the mapping. In order to obtain radon potential values in these areas, values were extrapolated by expanding the raster grid by 200 m based on the adjacent cells.

The raster grid was then converted back to a vector dataset as an ArcGIS shapefile without simplification of the cell boundaries.

The final RADON POTENTIAL ArcGIS shapefile was intersected with the British National Grid 5 km tile boundaries to split large polygons, and multipart polygons were converted to single part, to improve the performance of the final dataset.

The INDICATIVE ATLAS OF RADON IN GREAT BRITAIN dataset (Figure 1: Right; and Figure 2) was created from the buffered RADON POTENTIAL DATASET FOR GREAT BRITAIN (Figure 1: Left) by intersecting it with a 1-km grid and selecting the highest radon class (1-6) that occurred within each 1-km square.

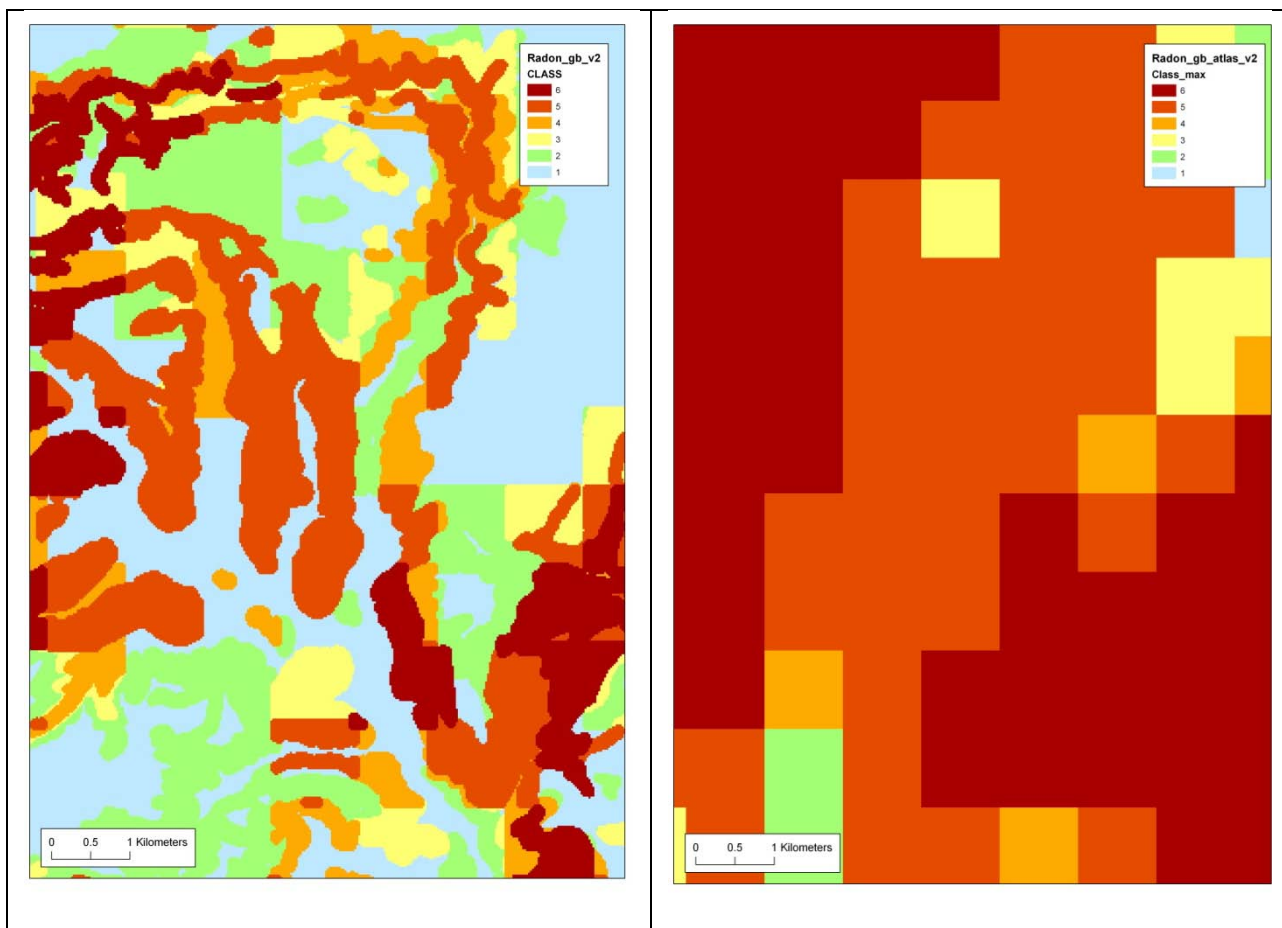


Figure 1 Extract from RADON POTENTIAL DATASET FOR GREAT BRITAIN (Left) and corresponding INDICATIVE ATLAS OF RADON IN GREAT BRITAIN DATASET (Right)

¹ Higher classes had priority over lower classes

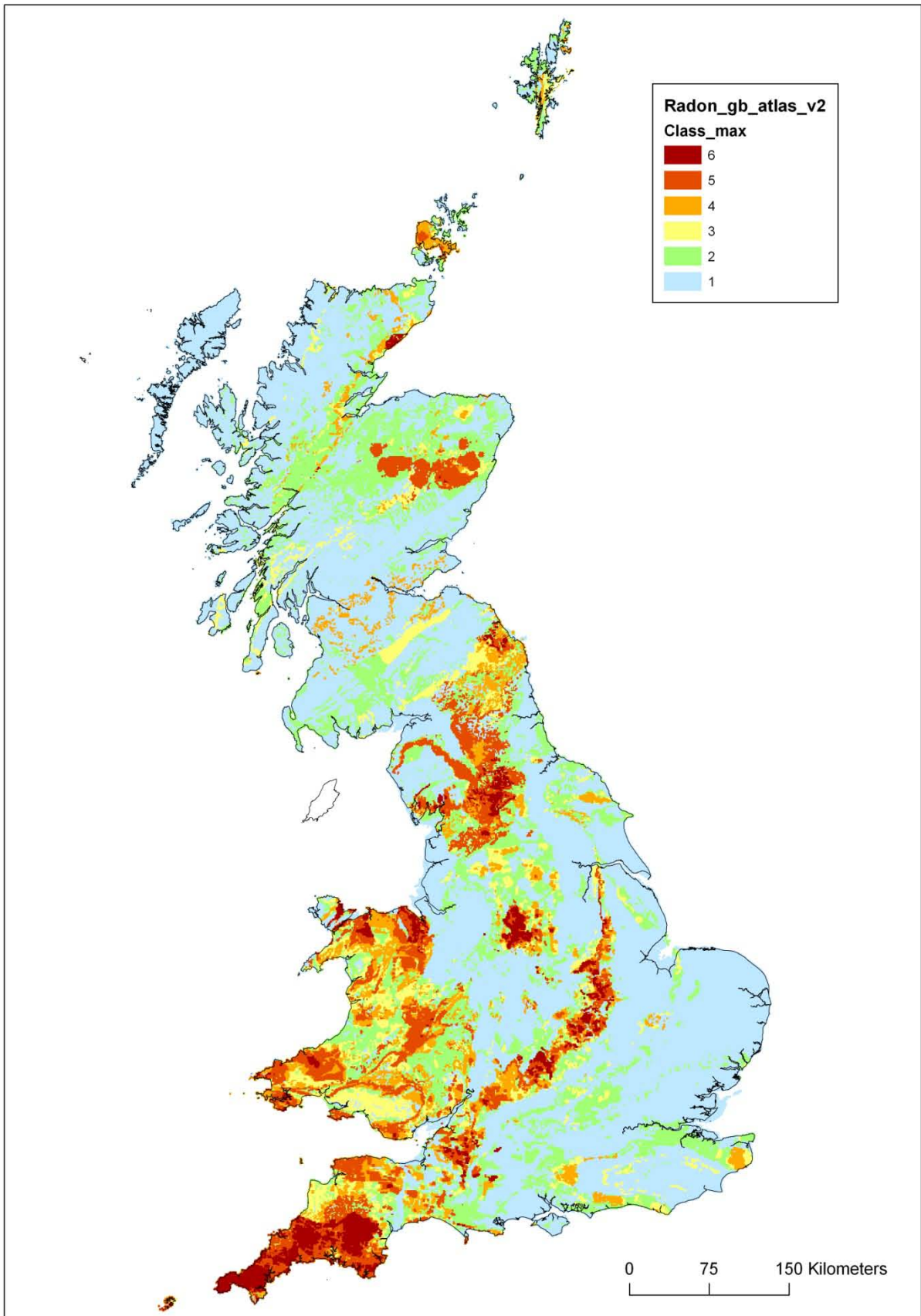


Figure 2 Indicative Atlas of Radon in Great Britain

3.5 USE OF OS ADDRESSPOINT TO SEARCH THE RADON POTENTIAL DATASET FOR SMALL BUILDINGS IN GREAT BRITAIN

The Ordnance Survey (OS) AddressPoint dataset can be used to query the Radon Potential Dataset to establish whether a building is in a radon Affected Area and to determine what level of radon protective measures are required for extensions or conversions to small existing buildings (see section 2.3 for more information).

OS AddressPoints should not be used when the footprint of the building (home or workplace) including any planned extension, exceeds 25 metres in any direction. For larger buildings groups of buildings and sites, the instructions in Section 3.6 should be followed.

During testing it was found that some OS AddressPoints joined to the buffered radon class dataset returned a value of 0 instead of a radon potential class value. This was due to the fact that if a point lies exactly on the boundary between polygons no value is returned in the GIS. It was discovered that some GIS systems **do** return a value in this situation and some **do not**. Also if a value is returned, it is not known which of the two possible values (from the two polygons either side of the polygon boundary) is going to be returned. To ensure consistency between different systems the dataset was moved by -0.01 of a metre in both the x and y directions. This then ensures that no AddressPoint can ever lie directly on top of a boundary between polygons. As it has been decided to use AddressPoints precise (rounded) to 1 metre, the final shifted dataset will have no boundaries that have coordinates exactly on metre boundaries. This is the final RADON POTENTIAL DATASET FOR GREAT BRITAIN.

When using OS AddressPoints against the data, they should be rounded to 1 metre using the following standard practice:

- 0.5 and above should be rounded up
- 0.49999999 (9 recurring) and below should be rounded down.

In the case of an OS AddressPoint, where only one digit occurs after the decimal point 0.5, 0.6, 0.7, 0.8, 0.9 should be rounded up and 0.4, 0.3, 0.2, 0.1 should be rounded down.

This pre-processing of the data should ensure that all RADON POTENTIAL DATASET FOR GREAT BRITAIN users will obtain the same result when using OS ADDRESS-POINT® data rounded to 1 metre as described above. Data users should not apply any further buffer to the rounded OS ADDRESS-POINT® coordinates, for example to define property extent, because a 25-m buffer for this purpose is already included in the RADON POTENTIAL DATASET FOR GREAT BRITAIN. Additionally, any other forms of spatial search against the data, e.g., measured grid references or site polygons, do not need to be buffered.

This pre-processed RADON POTENTIAL DATASET FOR GREAT BRITAIN has been subject to rigorous quality checks involving BGS and HPA personnel.

Important Note: At the date of this document, the BGS is investigating how best to deal with the positional accuracy flagging within AddressPoint (as described in the OS User Guide). It is likely that AddressPoints flagged up by OS as inaccurately located (e.g. because their position is interim and due for update) will have to be 'rejected' for searches, and users recommended to seek an alternative location method (e.g. grid reference, site plan). Please contact the BGS for more information.

3.6 SEARCHING THE RADON POTENTIAL DATASET FOR LARGE BUILDINGS OR SITES IN GREAT BRITAIN

When making spatial searches against the Radon Potential Dataset for larger buildings with a footprint greater than 25 metres, a polygon defining the spatial extent of the building (and extensions) should be used as the search area instead of the Ordnance Survey (OS) AddressPoint

coordinates. The highest value radon class encountered in the search area should be used for the overall result. **As the data is pre-buffered it is not necessary to buffer any search area other than to allow for any inaccuracies in defining the site outline.** The same procedure should be followed when using any other site outlines, such as for a building development site or for areas that include a number of buildings.

The Radon Potential Dataset can be used to establish whether a large building, groups of buildings or site is in a radon Affected Area and to determine what level of radon protective measures are required for new buildings or extensions, conversions and/or refurbishment to existing large buildings (see section 2.3 for more information).

3.7 DATASET HISTORY

This radon potential hazard information for Great Britain is based on Health Protection Agency (HPA) indoor radon measurements and BGS digital geology information. This product was derived from DiGMapGB-50 V3.14 (2006) bedrock, superficial and artificial data sets. Each data layer is rectified to align with British National Grid origin. The indoor radon data is used by the BGS with the agreement of the HPA. Confidentiality of measurement locations is maintained through data management practices.

The geological data are primarily derived from the 1:50 000 scale digital geological map of Great Britain, DiGMapGB-50. There are some areas of 1:250 000 scale geological data, for example, in upland areas of Wales and Scotland, where larger scale data are not available. BGS is continually surveying and resurveying areas of Britain, improving and updating the geological maps. The RADON POTENTIAL DATASET FOR GREAT BRITAIN is based upon the DiGMapGB-50 Version 3.14 (2006)

Derivation of radon potential data started as part of two DETR research projects, continued as part of the BGS GeoHazard programme and is currently under the Derived Products Team of the Information Products science area.

The RADON POTENTIAL DATASET FOR ENGLAND AND WALES (**Version 1**) was released in 2007.

The current RADON POTENTIAL DATASET FOR GREAT BRITAIN (**Version 2**) which incorporates new data for Scotland combined with RADON POTENTIAL DATASET FOR ENGLAND AND WALES (**Version 1**), was released in 2011.

The BGS and the HPA are committed to improving the RADON POTENTIAL DATASET as more information becomes available.

3.8 COVERAGE

Data is provided to identify estimated radon potential in Great Britain (the dataset does not include the Isle of Man).

3.9 DATA FORMAT

The RADON POTENTIAL DATASET consists of vector polygons and is available in a range of GIS formats, including ArcGIS (.shp), and MapInfo (.tab). More specialised formats may be available but may incur additional processing costs. Due to the differences in precision of different formats and to small changes in precision during translation between formats, the absolute position of features in different GIS systems may vary by a few millimetres on the ground.

Important note regarding GIS format conversion: It is strongly recommended that the data is used in the format supplied and not converted to other GIS formats as errors can be cumulative. These issues of precision may appear to be minor but can lead to different answers being reported by different GIS software solutions.

3.10 LIMITATIONS

- The RADON POTENTIAL DATASET FOR GREAT BRITAIN has been developed at 1:50 000 scale and must not be used at larger scales.
- A 75-m buffer has been applied to the 1: 50 000 scale base radon potential data. All spatial searches of the RADON POTENTIAL DATASET FOR GREAT BRITAIN should be done without applying any additional buffer.
- The RADON POTENTIAL DATASET FOR GREAT BRITAIN is concerned with radon potential related to NATURAL geological sources only. The data do NOT cover the impacts of man-made features, apart from the impact of ironstone mining over the Northampton Sand Formation.
- The RADON POTENTIAL DATASET FOR GREAT BRITAIN is based on, and limited to, an interpretation of the records in the possession of The British Geological Survey and The Health Protection Agency at the time the base radon potential data set was created (2006 for England and Wales, 2008 for Scotland).
- An indication of high radon potential does not necessarily mean that an individual property will have a high radon concentration and an indication of low radon potential does not mean that an individual property will have a low radon concentration. The only way to find out whether a property is in fact above, at or below the Action Level is to carry out a radon measurement. Guidance on measuring radon can be obtained from the HPA (www.hpa.org.uk/radiation/radon).
- All address searches against the data should be made using Ordnance Survey ADDRESS-POINT® coordinates (under the Terms & Conditions described by the Ordnance Survey) rounded to 1 metre as described in Section 3.5.
- Address searches against the data should take into account the positional accuracy flags within the ADDRESS-POINT® database, and users are recommended to seek alternative location methods for inaccurately located addresses (see 3.5 above).

4 Model Questions and Answers

There are two searches which can be made against the joint HPA-BGS RADON POTENTIAL DATASET FOR GREAT BRITAIN.

4.1 RADON AFFECTED AREA

QUESTION:

Is the property in a radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are estimated to be above the Action Level?

ANSWER:

Radon Potential Class*	Is the property in a Radon Affected Area?	Additional information
1	No	The property is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level). The property is not in a radon affected area.
2	Yes	The property is in an Intermediate probability radon area (1 to 3% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
3	Yes	The property is an Intermediate probability radon area (3 to 5% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
4	Yes	The property is in an Intermediate probability radon area (5 to 10% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
5	Yes	The property is in a Higher probability radon area (10 to 30% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
6	Yes	The property is in a Higher probability radon area (more than 30% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.

*The Radon Potential Class number should not be included in answers.

GUIDANCE:

The HPA recommends a radon 'Action Level' of 200 becquerels per cubic metre for the annual average of the radon gas concentration in a home. Where 1% or more of homes are estimated to exceed the Action Level (i.e. are in an Intermediate or Higher probability radon area) the area should be regarded as a radon Affected Area.

This report informs you whether the property is in a radon Affected Area and the percentage of homes that are estimated to be at or above the radon Action Level. This does not necessarily mean there is a radon problem in the property; the only way to find out whether it is above or below the Action Level is to carry out a radon measurement in an existing property.

HPA advises that radon gas should be measured in all properties within radon Affected Areas and that homes with radon levels above the Action Level (200 Bq m⁻³) should be remediated, and when achievable to below the Target Level of 100 Bq m⁻³. Householders with levels between the Target Level and Action Level should seriously consider reducing their radon level, especially if they are at greater risk, such as if they are current or ex smokers. Whether or not a home is in fact above or below the Action Level or Target Level can only be established by having the building tested. The HPA provides a radon testing service which can be accessed at www.ukradon.org.

The information in this report provides an answer to one of the standard legal enquiries on house purchase in England and Wales, known as CON29 Standard Enquiry of Local Authority (part 1); 3.13 Radon Gas: Location of the Property in a Radon Affected Area.

If you are buying a currently occupied property in a Radon Affected Area, you should ask the present owner whether radon levels have been measured in the property. If they have, ask whether the results were above the Radon Action Level and if so, whether remedial measures were installed, radon levels were re-tested, and the results of re-testing confirmed the effectiveness of the measures.

Further information on radon is available from HPA or www.ukradon.org

4.2 RADON PROTECTIVE MEASURES

QUESTIONS:

England and Wales: Is the property in an area where radon protective measures are required for new buildings or extensions to existing ones as described in publication BR211 (2007 edition)?

Scotland: Is the property in an area where radon protective measures are required for new buildings or extensions to existing ones as described in publication BR376 (1999)?

ANSWERS:

Radon Potential Class*	What level of radon protective measures are required for new buildings in England and Wales?	What level of radon protective measures are required for new dwellings in Scotland?
1	None**	None**
2	None	Stage 1
3	Basic	Stage 1
4	Basic	Stage 1
5	Full	Stage 2
6	Full	Stage 2

*The Radon Potential Class number should not be included in answers.

** in 2008 HPA recommended that building regulations be amended to ensure that all new buildings, extensions etc. include basic radon protective measures. At the time of writing, relevant UK authorities were considering this advice.

GUIDANCE:

When extensions are made to existing buildings in high radon areas, or new buildings are constructed in these areas, the Building Regulations for England, Wales and Scotland require that protective measures are taken against radon entering the building.

This report provides information on whether radon protective measures are required. Depending on the probability of buildings having high radon levels, the Regulations for England and Wales may require either:

1. No protective measures
2. Basic protective measures
3. Full protective measures

The Regulations for Scotland may require either:

1. No protective measures
2. Stage 1 protective measures
3. Stage 2 protective measures.

More details of the protective measures required in England and Wales are available in BR211 *Radon: Guidance on protective measures for new buildings* and for Scotland in BR376 (1999) *Radon: Guidance on protective measures for new dwellings in Scotland*. Additional information and guidance is available from the Building Research Establishment website (<http://www.bre.co.uk/radon/>)

The indicative maps showing where protective measures may be required in new buildings and extensions, conversions and refurbishments in existing buildings for England and Wales are available on the Building Research Establishment website at the following link: <http://www.bre.co.uk/radon/maps.html>

Whether or not a building is in fact above or below the radon Action Level can only be established by having the building tested. The HPA provides a radon testing service which can be accessed at www.ukradon.org or by telephone.

5 Further Information

5.1 RISKS OF RADON

Radon is a radioactive gas which occurs naturally. It has no taste, smell or colour. Special devices are needed to measure it. Radon comes out of the ground. Outdoors, it is diluted to very low levels. However, in some cases the radon level indoors can build up to high concentrations. In such cases, it does pose a serious risk to health.

5.2 ACTION LEVEL FOR RADON

The Health Protection Agency recommends that radon levels should be reduced in homes where the average is more than 200 becquerels per cubic metre of air (Bq m^{-3}). This recommendation has been endorsed by the Government. This Action Level refers to the annual average concentration in a home, so radon measurements are carried out with two detectors (in a bedroom and living room) over three months, to average out short-term fluctuations.

5.3 RADON AFFECTED AREAS

The Health Protection Agency defines radon Affected Areas as those with a 1% probability or more of a home having radon above the Action Level. The Health Protection Agency recommends that people in Affected Areas should test their homes for radon.

5.4 HOW TO REDUCE RADON LEVELS

HPA advises that radon gas should be measured in all properties within radon Affected Areas and that homes with radon levels above the Action Level (200 Bq m^{-3}) should be remediated, preferably to below the Target Level of 100 Bq m^{-3} . Householders with levels between the Target Level and Action Level should seriously consider reducing their radon level, especially if they are at greater risk, such as if they are current or ex smokers.

Indoor radon levels can usually be substantially reduced at a cost comparable to many home improvements, such as replacing carpets. Details of methods of reducing radon levels are given on the Building Research Establishment Website.

5.5 RADON IN THE WORKPLACE

Information on radon measurement in the workplace and in the home is available at:

<http://www.hpa.org.uk/ProductsServices/Radiation/RadonMeasurementServices/radon02Work/>
and

<http://www.hpa.org.uk/ProductsServices/Radiation/RadonMeasurementServices/radon01Home/>

Additional advice on radon in the workplace can be found at:

<http://www.hse.gov.uk/radiation/ionising/radon.htm>.

6 Contacts

Radon Survey
Health Protection Agency
Centre for Radiation, Chemical and Environmental Hazards
Chilton
Didcot
Oxon
OX11 0RQ
Tel: 01235 822622
Fax: 01235 833891
Email: radon@hpa.org.uk
Web: www.UKradon.org

Enquiries
British Geological Survey
Kingsley Dunham Centre
Keyworth
Nottingham
NG12 5GG
Tel: 0115-936-3143
Fax: 0115-936-3276
Email: enquiries@bgs.ac.uk
Web: <http://www.bgs.ac.uk>

Building Research Establishment, advice on radon: www.bre.co.uk/radon/

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8 References

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