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User guide: Radon potential for Northern Ireland

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User Guide for the UKHSA-GSNI-BGS Joint Radon Potential Dataset for Northern Ireland

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Foreword

The UK Health Security Agency (UKHSA), the Geological Survey of Northern Ireland (GSNI) and British Geological Survey (BGS), have published mapping to determine the risk of radon exposure in buildings in Northern Ireland. 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.

The UK Health Security Agency was formed in 2021 having been previously known as Public Health England. It undertakes research to advance knowledge about protection of people from the risks of radiation; provides laboratory and technical services; runs training courses; provides expert information and has a significant statutory role in the UK.

The Geological Survey of Northern Ireland (GSNI) is an office of the Department for the Economy (DfE), Northern Ireland. It is staffed by scientists of BGS under contract to DfE, which allows GSNI to call upon expertise from within other parts of the BGS. GSNI also advises other Northern Ireland government departments. GSNI provides geoscience information and services to inform decision making and holds an extensive archive of maps, boreholes, and site investigation reports; detailed urban and regional geochemical and geophysical data, and publishes books, memoirs, and reports. The GSNI maps, models, and monitors the ground and this research underpins decision making, promotes economic development and generates baseline data for environmental management.

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The BGS is a component body of the Natural Environment Research Council (NERC), part of UK Research and Innovation (UKRI).

Contents

Summary

The UK Health Security Agency (UKHSA), the Geological Survey of Northern Ireland (GSNI) and British Geological Survey (BGS), have published mapping to determine the risk of radon exposure in buildings in Northern Ireland. The map, and the underlying digital dataset, are based on statistical analysis of radon levels in dwellings, many funded by the Northern Ireland Environment Agency (NIEA), within the framework of 1:10 000 and 1:250 000 scale GSNI digital geology.

The map provides an assessment of the likelihood of a property having a radon concentration at or above the Action Level based on its location. The data does not provide the actual radon level within a specific property – this can only be determined from a measurement within the building. The map shows the Affected Area levels defined by UKHSA, and Radon Protection levels as described in the latest Building Research Establishment guidance on radon protective measures for new buildings BR 211 guidance (Scivyer 2015). Guidance is also available here: www.finance-ni.gov.uk/sites/default/files/publications/dfp/AMD%207%20final.pdf.

The information provided in this User Guide is intended to provide a quick-start guide to using and understanding this UKHSA/GSNI/BGS data product.

Acknowledgements

This report was updated and reformatted in 2022 to provide updated contact details, and a new colour scheme to reflect the revised Radon Potential Map of Great Britain. Note that the dataset for Northern Ireland remains unchanged since the version published in 2015 (only the colours and user guidance have been edited.

Introduction

The Radon Potential data classifies areas based on their likelihood of a property having a radon level at or above the Action Level in Northern Ireland.

Radon is a natural radioactive gas, which enters buildings from the ground and persists or accumulates where ventilation is poor. Radon is the biggest source of human exposure to ionising radiation in the UK and prolonged exposure to elevated levels increases the risk of lung cancer. Indoor radon is responsible for an estimated 1100 lung cancer deaths a year (McColl et al., 2010).

The UK is required to set a reference level for the exposure of members of the public to indoor radon (The Ionising Radiation (Basic Safety Standards) (Miscellaneous Provisions) Regulations 2018, SI 482/2018). The Action Level for UK homes is 200 Bq m^{-3}. UKHSA recommends that radon levels should be reduced in homes where the annual average radon concentration is equal to, or greater than, the Action Level. The Radon Potential data was developed in order to meet these UKHSA definitions.

The Industrial Pollution and Radiochemical Inspectorate of the Northern Ireland Environment Agency (NIEA) and the Health Protection Agency (HPA–now part of UK Health Security Agency) published a report on Radon in Dwellings in Northern Ireland (Green et al., 2009) containing maps based on radon results from over 23 000 homes. The maps of radon potential in that report were derived from radon measurements and presented as average radon potential in each 1-km square on the Irish grid within Northern Ireland.

Miles and Appleton (2005) demonstrated that combining geological and grid square radon mapping, as described in this report, provides more accurate mapping than either method used separately. The combined mapping method has been used to produce the current radon datasets and indicative atlases for England and Wales (Appleton and Miles, 2005; Miles et al., 2007; Appleton et al., 2011; Scheib et al., 2013) and Scotland (Scheib et al., 2009; Miles et al., 2011).

The radon potential dataset described in the current report replaces the HPA-NIEA 1-km grid radon map published in 2009 (Green et al., 2009). This Radon Potential Dataset for Northern Ireland is based on indoor radon measurements made by UKHSA and 1:10 000 scale digital geology information provided by the Geological Survey of Northern Ireland (GSNI), or 1:250 000 scale digital geology in those areas where the 1:10 000 data is not yet available. The measured indoor radon data is used with the agreement of UKHSA. Confidentiality of measurement locations is maintained through data management practices. Access to the data is restricted.

The general methodology by which the UKHSA-GSNI-BGS joint radon dataset for Northern Ireland was produced is described in Miles and Appleton (2005) and Appleton et al. (2011). This report provides greater detail on the methodology and guidance on how the dataset can be used. Searches of the full dataset are available by individual address or site area from the UKHSA and BGS enquiries services.

The Radon Potential is shown in six discrete Radon Classes (RnC 1 to RnC 6) with increasing Radon Potential (RnP, see Table 1). The areas classified as RnC 2 (Radon Potential equal or above 1% and less than 3%) up to RnC 6 (Radon Potential greater than 30%) are considered by the UKHSA as Radon Affected Areas. These Radon Classes are used to identify areas where a radon measurement

is recommended by UKHSA, and also for building regulation purposes to determine the level of radon protection required in new or renovated buildings.

An indicative version of the full data set for Northern Ireland (showing only the maximum radon potential in each 1-km grid square) was published in 2015 (Rees et al, 2014), and (Daraktchieva et al, 2015).
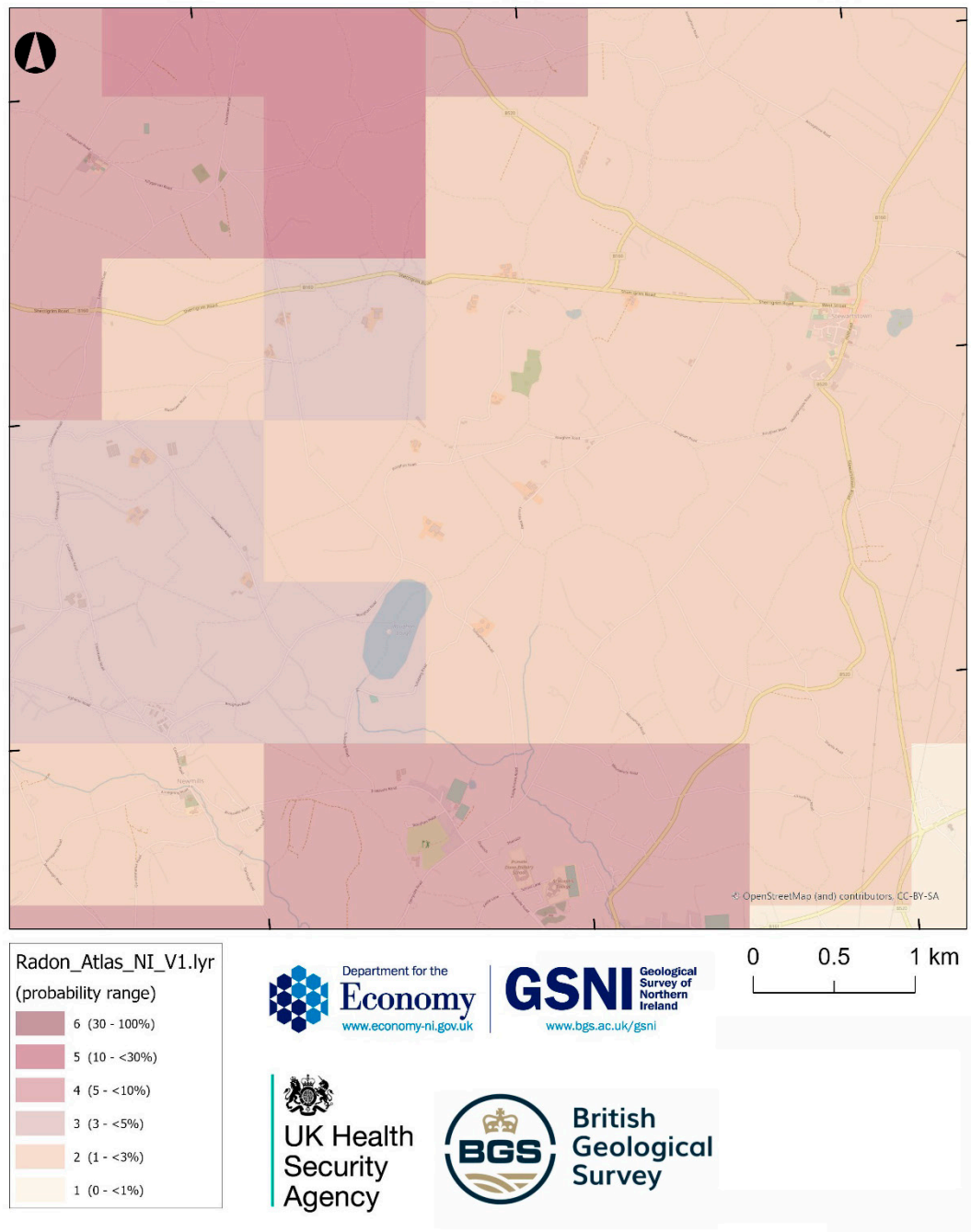

Figure 1 Example radon data (Indicative atlas for Northern Ireland).

Case study: new housing development proposals

Local planning authorities require the implementation of radon gas preventative measures for new buildings when granting permission for a new housing development. These requirements were previously defined in BR413 Radon: Guidance on protective measures for new dwellings in Northern Ireland (2004) and updated in BR 211 guidance (Radon: Guidance on protective measures for new buildings BRE 211 (Scivyer 2015)). Additional information and guidance is available from the Building Research Establishment website (www.bre.co.uk/radon/).

Why does radon potential matter?

Radon gas is a recognised health hazard with a link identified between long-term exposure and lung cancer. Preventing radon gas accumulation in property is subject to building regulation guidance (BRE 211, Scivyer 2015). There is therefore a need for wider and more effective use of national environmental information such as mapping of 'radon potential' for strategic planning policy (e.g. Local Development Plans) and to inform developers.

How do local authorities and construction companies use radon potential data?

In Northern Ireland, proposals for a new housing development are typically submitted to the local planning authority for approval. In drafting the proposal, the planning officer and the developer will have to preview via the online service provided by UKHSA (www.ukradon.org/information/ukmaps) and BGS (www.bgs.ac.uk/datasets/radon-data-indicative-atlas-of-radon/) (see Figure 2A). The Indicative Atlas uses a 1 km x 1 km grid to provide a generalised overview (at an approximate scale of 1:1 000 000) indicating the maximum radon gas potential observed in each grid square.

The developer is most likely to have used the free online service to preview the maximum radon potential. The planning officer may have also used the same online resource, or may have used a more detailed licensed version available from BGS (www.bgs.ac.uk/datasets/radon-data-radon-potential-dataset/, see Figure 2B). From the **Indicative Atlas**, the planning officer and developer can independently determine that the new development area lies within an area of **maximum** Radon Class 5 (Radon Potential from 10 to 30 %), and, that the specific class at the given location of the site lies between RnC1 and RnC5.

Figure 2 Proposed site (red square) (A) Indicative atlas (1:100 000 scale) (B) Licence Radon Potential data (1:50 000 scale).

The information contained within the licensed **Radon Potential Dataset** is provided at a greater spatial resolution than the free Indicative Atlas, revealing the variation in radon potential within a given kilometre grid square (see Figure 2B) at 1:50 000 scale.

The Planning Officer can now re-assess the proposed development site against the higher resolution Radon Potential Dataset and see that the site is within Radon Class 2 (1-3% probability of exceeding the Action Level). This additional information enables the planning officer to advise the developer further on managing specific aspects of construction, or to request further actions as conditions of the development receiving permission.

Since the proposed development site is not located in the lowest Radon class (i.e. Class 1: radon potential from 0 to 1%), it is identified as a Radon Affected Area (see Table 1).

Radon Guidance on protective measures for new buildings BR 211 (Scivyer 2015) states that developers are mandated to consult the Radon Potential Dataset (jointly developed and approved by BGS and UKHSA) in all areas of Class 2 or above (i.e. radon potential greater than 1%).

How does the data provide a solution?

In the example given in Figure 2, the development site is located in a Radon Affected Area, as defined by UKHSA. One to three percent of dwellings in this site are estimated to have indoor radon concentrations above the Action Level.

The site lies within an area identified as intermediate probability for radon, the planning officer and developer now know that 'Zone 1 radon protective' measures are required as this site is in Northern Ireland (see Table 1) for how the action levels are classified, and which protection measures are required for England, Wales, Scotland and Northern Ireland).

Table 1 Radon Potential Classes (RnC).

Radon CLASS (RnC)	Radon affected area?	Nominal estimated percentage band of dwellings exceeding the Radon Action Level (Radon Potential, RnP)	Actual estimated percentage band of dwellings exceeding the action Action Level (RnP)	Level of protection required		
				England & Wales	Scotland	Northern Ireland
1	No	0-1	0 < RnP < 1	None	None	**None**
2	Yes	1-3	1 ≤ RnP < 3	None	Basic	**Zone 1 protective measures**
3	Yes	3-5	3 ≤ RnP < 5	Basic	Basic	**Zone 1 protective measures**
4	Yes	5-10	5 ≤ RnP < 10	Basic	Basic	**Zone 1 protective measures**
5	Yes	10-30	10 ≤ RnP < 30	Full	Full	**Zone 2 protective measures**
6	Yes	30-100	RnP ≥ 30	Full	Full	**Zone 2 protective measures**

≤ less than or equal to

< less than

≥ greater than or equal to

Note that the developer can simply accept the information provided by the freely-available Indicative Atlas as it provides a conservative radon class (equal to, or higher than, the actual Radon class), and so apply the corresponding preventive measures which in the example given above, would be 'Zone 2 protective measures'.

Access to the Radon Potential Dataset ensures Local Authorities and developers are better informed. This dataset ensures that local authorities can recognise the importance of radon and its potential long-term impact on human health, while developers can more effectively plan new buildings, taking into account the radon risk of the area and adjusting the needs of their development accordingly.

What are the outcomes and value?

The use of BGS/UKHSA information in their data analysis provides Local Authorities with early strategic knowledge of key discernible regional variations in land characteristics and potential land-supply, as well as potential constraints across Local Authority areas. These include zones classed as Radon Affected Areas. Use of the BGS/UKHSA datasets provides Local Authorities with greater leverage and capacity to forward plan risk and investment approaches with multiple stakeholders.

Examples include:

- The need for different spatial strategies across the Local Authority area to overcome different development challenges
- The likely need for different investment models to deliver housing infrastructure in different parts of the Local Authority area
- Enabling the Local Authority to request early, appropriate, and proportionate requests for site investigation from developers and construction teams through successive stages of the planning and development process

Ultimately, the Local Authority and developers can use this data to plan more effective and safer building of dwellings, optimising design to suit available land.

Methodology

Background

Radon is a naturally occurring radioactive gas, which enters buildings from the ground. 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 (McColl et al., 2010). UKHSA 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 value is termed the Action Level. UKHSA 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}.

The joint UKHSA-GSNI-BGS digital Radon Potential Dataset for Northern Ireland provides the current definitive map of radon Affected Areas in Northern Ireland.

Brief summaries of the main relationships between radon and geology in Northern Ireland are available in Appleton et al. (2008; 2011) and a more detailed review in Appleton et al. (2015). Comparison of the simplified geological map (Figure 3) with the radon potential map (Figure 4)
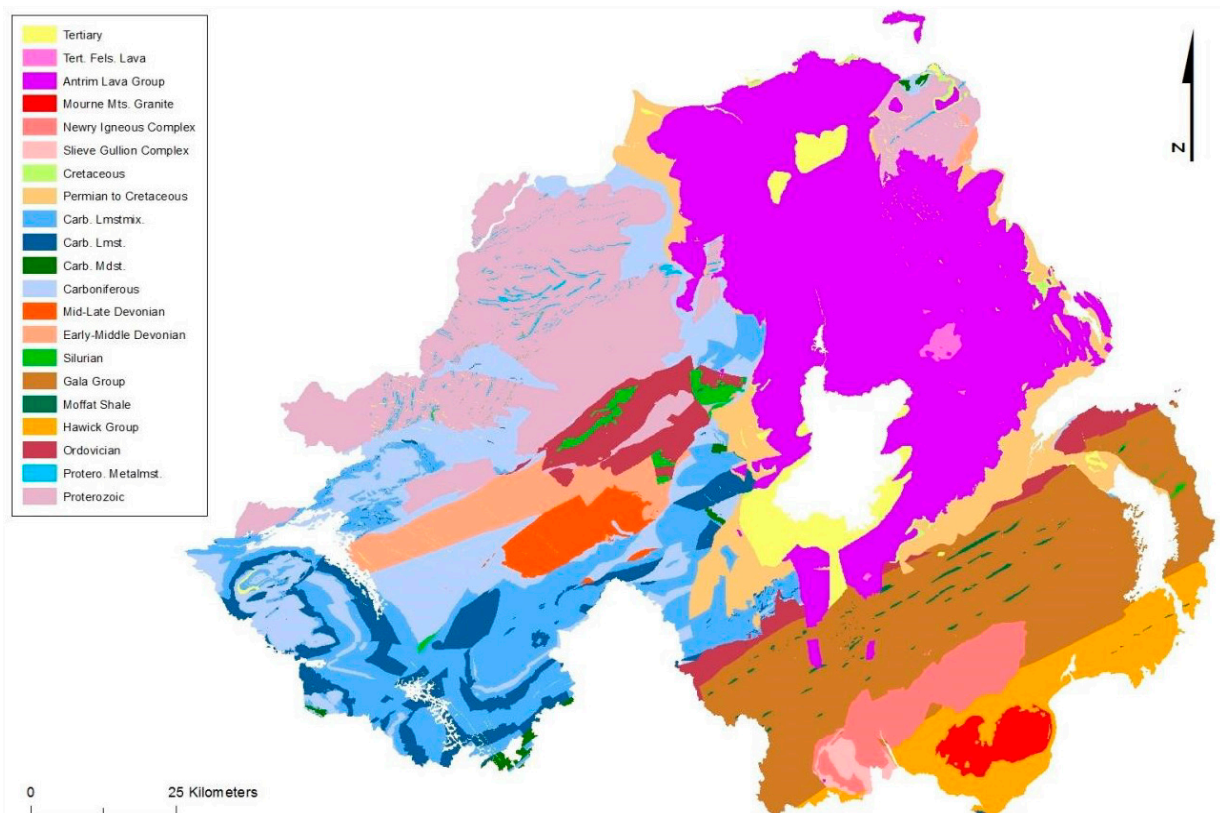
Figure 3 Simplified Bedrock Geology of Northern Ireland.

shows that moderate and high radon potential in Northern Ireland is associated mainly with (i) Neoproterozoic psammites, semipelites, meta-limestones and volcanics; (ii) Silurian Hawick Group greywackes and, to a much more limited extent Gala Group greywackes; (iii) Ordovician and Silurian acid intrusives and volcanics (iv) Middle-Late Devonian conglomerates; (v) Lower Carboniferous (Dinantian) limestone; (vi) Palaeogene (Tertiary) and Late Caledonian acid intrusive rocks of the Mourne Mountains Complex, Slieve Gullion Complex and Newry Granodiorite Complex.

Moderate to high radon potential is sometimes associated with glaciofluvial sand and gravel deposits where these overlie a range of bedrocks, some of which have relatively low radon potential. In this latter case the enhanced radon potential is probably caused by the high permeability of superficial deposits. Radon potential tends to be lower when bedrocks characterised by moderate or high radon potential are overlain by relatively impermeable silt-clay alluvium, glaciolacustrine, and lacustrine deposits; peat; and glacial till and moraine. Redistribution of rock debris derived from uranium-rich bedrocks, such as the Mourne mountains granites, through glacial, alluvial, and other processes can also result in higher radon potential being associated with superficial deposits relative to underlying bedrocks.
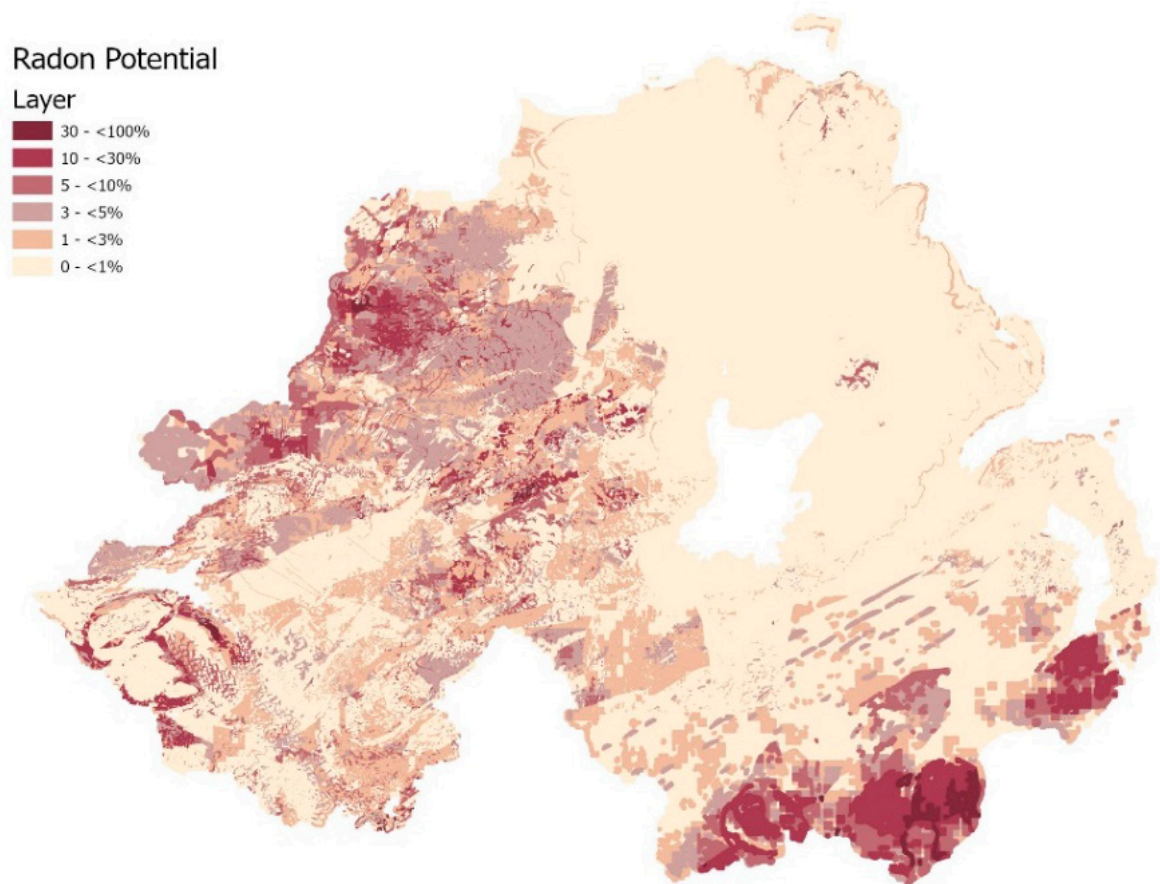
Figure 4 Radon Map of Northern Ireland Based on geology and indoor radon data.

Overview

Previously, the potential for high radon levels in UK dwellings has been mapped on the basis of either grouping the results of radon measurements in dwellings by grid squares (by UKHSA), or by geological units (by BGS).

In both cases, lognormal modelling of the distribution of radon concentrations was applied to allow the estimated proportion of dwellings at or above the UK Radon Action Level (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, 2005).

An overview of the comparison between specific types of geology of Northern Ireland and the distribution of radon potential is given above.

The land area is first divided up using a combination of bedrock and superficial geological characteristics derived from GSNI 1:10 000 DiGMap and 1:250 000 scale digital geological map data (Figure 1; GSNI 1991, 1997). Each different combination of geological characteristics may appear at the land surface in many discontinuous locations across the country.

In order to facilitate the seamless 1-km interpolation of radon potential within major geological units, simplified bedrock and superficial geology classification systems were developed. These ensure continuity and also group some geological units with similar characteristics. Grouping similar geological units ensured that there were a sufficient number of indoor radon measurements for intra-geological unit grid square mapping to be carried out over a greater proportion of Northern Ireland. There are 360 named 1:10 000 scale bedrock geological units in Northern Ireland and 44 bedrock units in the area with only 1:250 000 scale bedrock geology (Figure 1). These were grouped using a simplified bedrock classification comprising 69 units. There are 12 individually named 1:250 000 scale superficial geological units and 27 1:100 000 scale superficial geology units. A simplified superficial geology classification comprising 14 units was used in the radon mapping procedure. Once the superficial geology has been unioned with bedrock geology there are a total of 466 bedrock/superficial geology combinations.

Accurate coordinates for house measurement results are required for the radon mapping method. Of the approximately 24 000 radon measurements for domestic dwellings available in Northern Ireland, 23 000 have precise coordinates obtained from the *Land and Property Services (LPS) Pointer®* (from now on referred as *Pointer®*) location data. These results were used for preparing the radon maps.

Each of these measurements is allocated to the 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 10.1:

- To include a 'geological data accuracy' buffer of 10 m or 250 m to allow for the precision (uncertainty) of the geological lines as defined as part of the 1:10 000 or 1:250 000 scale geological data 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 *Pointer®* coordinates

The 'geological data accuracy' and 'residential property' buffers were added together, and the resultant 35 m or 275 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 superimposed on each other to produce a final 25 m raster grid this gives the highest radon probability for each individual 25 m cell.

The radon potential dataset 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 shape file without simplification of the cell boundaries.

The final Radon Potential ArcGIS shape file was intersected with the Irish Grid 1-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 Northern Ireland dataset was created from the buffered Radon Potential Dataset for Northern Ireland after intersecting it with a 1-km grid, by selecting the highest radon class (1-6) that occurred within each 1-km square.

Technical information

This section provides more information on the data product, its content and advice on best use, as well as highlighting some important considerations.

Definitions

The Joint Radon Potential Dataset for Northern Ireland is split into two layers:

- Radon Potential Dataset for Northern Ireland (Radon_NI_V1) provides the current definitive map of radon Affected Areas in Northern Ireland
- The Indicative Atlas of Radon in Northern Ireland Dataset (Radon_Atlas_NI_V1) presents a simplified version of the Radon Potential Dataset for Northern Ireland 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 Northern Ireland is published in Daraktchieva et al., 2015. The Indicative Atlas should not be used to provide reports for sites unless all the site lies within a grid square with <1% of dwellings predicted to exceed the Radon Action Level (Class 1)

Scale

The Radon Potential Dataset for Northern Ireland has been developed at a combination of 1:10 000 and 1:250 000 scales and must not be used at larger scales. Figure 5 (below) shows the areas of Northern Ireland where the two scales of data have been applied.

Figure 5   Mapping scales applied to the geological map of Northern Ireland.

Coverage

The dataset covers Northern Ireland as shown in Figure 6 (below).
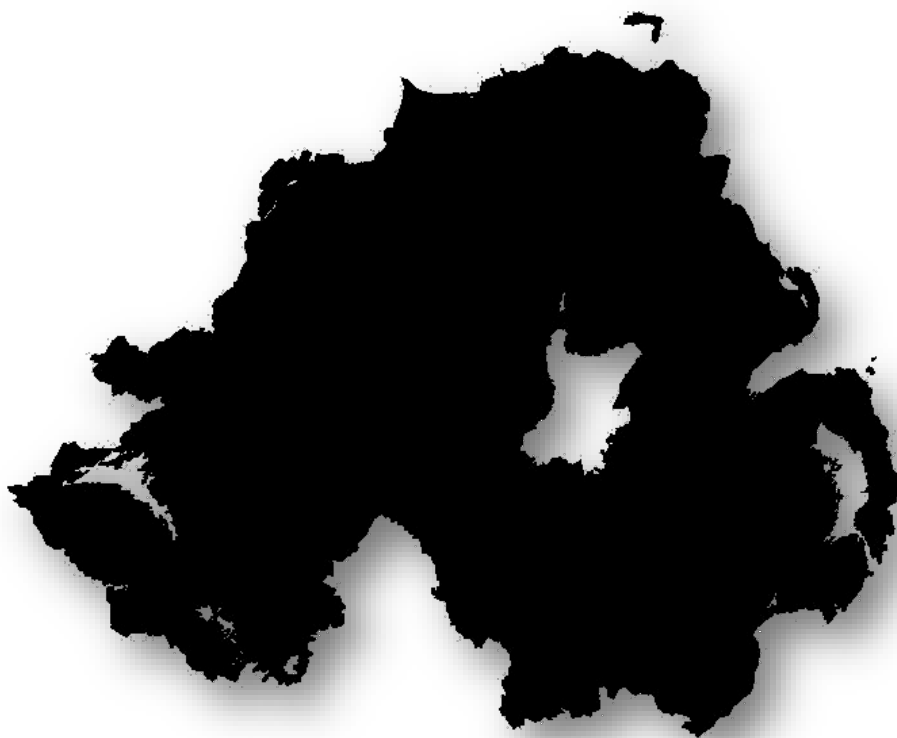
Figure 6 Coverage of the Radon Potential Map.

Source datasets

The following source datasets are compiled into the Radon Potential Dataset:

- GSNI Geology 10 k and 250 k (Bedrock and Superficial)
- UKHSA Indoor Radon Measurements
- Ordnance Survey of Northern Ireland 1 km Irish National Grid
- OSNI open data (www.opendatani.gov.uk/@land-property/osni-open-data-largescale-boundaries-ni-outline1)

Attribute descriptions

The Radon Potential Dataset has the attributes described in Table 2 below.

Table 2 Attribute table: field names and descriptions

Field name	Field type	Description	Field content
CLASS	Integer	Radon Potential Class	Range: 1 to 6∗
Potential (shown only in the layer file)	String	Nominal percentage band of dwellings estimated be at or above 200 Bq m^{-3}	0-<1; 1-<3; 3-<5; 5-<10; 10-<30 or 30-100
VERSION	String	Dataset title and version number	RadonNI V1
REGION	String	Area covered	Northern Ireland

∗ A given area of land is assigned to one of six discrete Radon Classes 1 to 6 with increasing Radon Potential.

Data format

The Radon Potential Dataset has been created as vector polygons and is available in ESRI shapefile (.shp) format. More specialised formats may be available but may incur additional processing costs. Please email BGS Enquiries (enquiries@bgs.ac.uk) to request further information.

Dataset history

This radon potential hazard information for Northern Ireland is based on domestic radon measurements undertaken by UK Health Security Agency (UKHSA) and GSNI digital geology information. This product was derived from the GSNI 1:10 000 and 1:250 000 scale digital bedrock and superficial geology geological map data of Northern Ireland.

(www.bgs.ac.uk/gsni/geology/status/index.html). Each data layer is rectified to align with Irish National Grid origin. The measured indoor radon data is used by the BGS with the agreement of UKHSA. Confidentiality of measurement locations is maintained through data management practices.

Derivation of radon potential data started as part of the DETI (now DfE) Tellus project (Young and Earls, 2007), and was completed by the Derived Products Team of the Information Products science area of BGS.
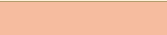
The current Radon Potential Dataset for Northern Ireland (Version 1.0) was released in 2015.

The UKHSA, GSNI, and BGS are committed to improving the Radon Potential Dataset as more information becomes available.

Displaying the data

It is recommended that data is displayed based on the CLASS field in the attribute table. This indicates the estimated percentage of dwellings exceeding the Radon Action Level. An ESRI layer file is provided with the dataset, but for users of other GIS software, the colour palette values are shown in Table 3. Note that the colours have been updated in December 2022 to match with those published in the Radon Potential map of Great Britain (Version 3). Only the colour ramp has been altered, all other aspects of the Northern Ireland datasets remain the same.

Table 3 Colour palette for Radon Potential Class.

Radon class*	Radon potential band	RED	GREEN	BLUE	HEX	Looks like
1	0 - <1%	254	240	217	#FEF0D9	
2	1 - <3%	231	188	159	#E7BC9F	
3	3 - <5%	197	162	159	#C5A29F	
4	5 - <10%	176	108	114	#B06C72	
5	10 - <30%	154	60	82	#9A3C52	
6	30 - 100%	118	46	63	#762E3F	

Use of *Pointer®* to search the Radon Potential Dataset for small buildings in Northern Ireland

Pointer® is the address database for Northern Ireland maintained by Land & Property Services (LPS), with input from Local Councils and Royal Mail. *Pointer* 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 larger (>30 m^2) extensions to small existing buildings.

Pointer® address coordinates 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, see the instructions below specifically for large buildings/sites.

During testing it was found that some *Pointer®* address coordinates joined to the buffered radon class dataset returned a value of 0 instead of a radon potential class value. It was identified that these are coordinates that sit on the join between two neighbouring polygons. Further investigation discovered that other GIS software do return a value but when a value is returned, it is not known which of the two possible values (from the two polygons either side of the polygon boundary) will be returned. To ensure consistency between different systems the dataset was moved by -0.01 of a metre (1 cm) in both the x and y directions. This then ensures that no *Pointer®* address coordinates can ever lie directly on top of a boundary between polygons. As the *Pointer®* address coordinates are held to 1 metre accuracy ('Pointer technical specification' link in www.nidirect.gov.uk/pointer), the final shifted dataset will have no boundaries that have coordinates exactly on metre boundaries.

This pre-processing of the data should ensure that all Radon Potential Dataset for Northern Ireland users will obtain the same result when using *Pointer®* address coordinates. Data users should not apply any further buffer to the *Pointer®* address coordinates, for example to define property extent, because a 25 m buffer for this purpose is already included in the Radon Potential Dataset for Northern Ireland. 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 Northern Ireland has been subject to rigorous quality checks involving BGS and UKHSA personnel.

Searching the Radon Potential Dataset for large buildings or sites in Northern Ireland

When making spatial searches against the Radon Potential Dataset for larger buildings with a footprint greater than 25 m, a polygon defining the spatial extent of the building (and extensions) should be used as the search area instead of the *Pointer®* address coordinates. The highest value radon potential band 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 larger (>30 m^2) extensions to existing large buildings.

Dataset limitations

Data content

The Radon Potential Dataset has been constructed by combining **10 k and 250 k geological mapping by GSNI** with UKHSA indoor radon measurements. Consequently, the values within this dataset are limited by the components on which they are based. Given the method described within this document, the values are provided here to the best of our knowledge and current data holdings.

The Radon Potential Dataset for Northern Ireland is associated with radon potential related to natural geological radon sources only. The data do not cover the impacts of man-made features.

The Radon Potential Dataset for Northern Ireland is based on, and limited to, an interpretation of the records in the possession of BGS and UKHSA (formerly HPA, then PHE) at the time the base radon potential dataset was created (November 2013).

An indication of high radon potential for an area does not mean that an **_individual_** property will have a high radon concentration; similarly, an indication of low radon potential area does not mean that an **_individual_** property will have a low radon concentration (classes are based on probabilities of a percentage of dwellings exceeding the action level, not ALL dwellings). The only way to determine whether a specific property is above, at, or below the Action Level is to carry out a radon measurement. Guidance on measuring radon can be obtained from UKHSA (www.ukradon.org).

All address searches against the data should be made using _Pointer®_ address coordinates (under the Terms & Conditions described by LPS).

Scale

The Radon Potential Dataset for Northern Ireland has been developed at a combination of 1:10 000 and 1:250 000 scales and must not be used at larger scales. Figure 5 (Appendix 1) shows the areas of Northern Ireland where the two scales of data have been applied.

A 35 m buffer has been applied to the 1:10 000 scale base radon potential data and a 275 m buffer to the 1:250 000 scale data. All spatial searches of the Radon Potential Dataset for Northern Ireland should be done without applying any additional buffer.

Accuracy/uncertainty

The mapping accuracy associated with the GSNI Geology 10 k and 250 k is nominally 1 mm, which equates to 10 m on the ground at 1:10 000-map scale, and 250 m on the ground at 1:250 000-map scale. This is only a measure of how faithfully the lines are captured. Consequently, this dataset should not be used at viewing scales finer than 1:10 000.

The indoor radon measurements are derived from individual delivery point locations (x/y coordinates) which are processed to give a spatial average across a 1 km grid square. The spatial variation of the measurements is calculated and resolved using statistical methods, which may result in uncertainty. This is inherent in any form of spatial interpolation.

Artefacts

Inconsistencies in the underlying geological mapping may result in mismatched legacy sheet boundaries resulting in unexpected changes in Radon Potential Class.

Frequently asked questions

The questions and answers below have been provided to address any potential issues relating to how the product can be used or how it can be interpreted. If you have any additional questions, please contact enquiries@bgs.ac.uk.

Q: Is my property in a radon affected area as defined by UK Health Security Agency (UKHSA) and if so what percentage of homes are estimated to be at or above the Action Level?

A: The Radon Potential dataset can be used to identify whether a property is in a Radon Affected Area and the percentage of homes that are estimated to be at, or above, the radon Action Level. The Radon class for an area is shown in the dataset, along with text describing the nominal estimated percentage band of dwellings exceeding the Radon Action Level (see table below). Being in a Radon Affected Area does not mean there is a specific radon level in the property; the only way to determine the radon level is to carry out a measurement. UKHSA (formerly PHE) provides a validated radon testing service, which can be accessed at www.ukradon.org.

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.

The UK is required to set a reference level for the exposure of members of the public to indoor radon (The Ionising Radiation (Basic Safety Standards) (Miscellaneous Provisions) Regulations 2018, SI 482/2018). The Action Level for UK homes is 200 Bq m^{-3}. UKHSA (formerly PHE) recommends that radon levels should be reduced in homes where the annual average radon concentration is at, or above, the Action Level.

Q: If the property is in a radon-affected area what should be done?

A: UKHSA and NIEA (www.nidirect.gov.uk/articles/radon-gas-your-home) advise that radon gas should be measured in all properties within Radon Affected Areas and that homes with radon levels at or above the Action Level (200 Bq m^{-3}) should be to lower to the radon level; and when achievable to below the Target Level of 100 Bq m^{-3}. Householders with levels between the Target Level (100 Bq m^{-3}) 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.

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 UKHSA or www.ukradon.org.

Q: Is my property in an area where radon protective measures are required for new buildings or larger (>30 m^2) extensions to existing ones as described in the Building Research Establishment publication BRE-211, 2015.

A: When extensions larger than 30 m^2 are made to existing buildings in Zone 1 or Zone 2 radon areas, or new buildings are constructed in these areas, the Building Regulations 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 Northern Ireland may require either:

- No protective measures
- Zone 1 protective measures
- Zone 2 protective measures

Radon Potential Class*	What level of radon protective measures are required for new buildings in Northern Ireland?
1	None
2	Zone 1 protective measures
3	Zone 1 protective measures
4	Zone 1 protective measures
5	Zone 2 protective measures
6	Zone 2 protective measures

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

More details of the protective measures required in Northern Ireland are available in Building Research Establishment guidance on radon protective measures for new buildings BR 211 (2015).

Additional information and guidance are available from the Building Research Establishment website (www.bre.co.uk/radon/).

Whether or not an existing building is in fact above or below the radon Action Level can only be established by having the building tested. UKHSA provides a radon testing service which can be accessed at www.ukradon.org or by telephone (01235 822622). Other validated radon testing services are available.

Q: Why have the colours been changed for the Northern Ireland Mapping (in 2022)?

A: Colours have been changed to accommodate the new colour palette being used for the Radon Map of Great Britain (which was updated in 2022). The new colours are designed to make it easier to differentiate the different radon classes, and to allow comparison of locations across Great Britain and Northern Ireland. Note that only the colouration of the map has changed, no other component of the mapping has been altered.

Q: Has the radon potential map for Northern Ireland been updated since 2015?

A: No, the radon potential map for Northern Ireland has not been updated. This is because the geological dataset has not changed, and the number of homes measured since the radon map publication in 2015 has not been sufficient to justify re-mapping. The colours in the current NI map have been altered to match those used in the new GB map and user guidance has been edited to provide updated contact details.

The NI map is otherwise identical in every other way to the one published in 2015.

Q: What is radon?

A: Radon is colourless, odourless radioactive gas. It is formed by the radioactive decay of the small amounts of uranium that occur naturally in all rocks and soils. Radon is probably the second largest cause of lung cancer to the UK population after tobacco smoking. Due to the underlying geology, indoor radon can reach levels at which action should be taken to reduce them.

Q: What is the Action Level for radon?

A: UKHSA recommends that radon levels should be reduced in homes where the average is at or above 200 Becquerels per cubic metre of air (Bq m^{-3}). This recommendation has been endorsed by UK Government.

The Action Level refers to the annual average concentration in a home. To assess this, radon measurements are carried out with two detectors (in a bedroom and living room) over three months, to average out short-term fluctuations. Also see 'What can I do if my property has high radon levels?' (below).

Q: What is a Radon Affected Area?

A: A radon Affected Area is classed as an area where at least 1% of current or future homes are expected to be at or above the Radon Action Level of 200 Bq m^{-3}.

Radon Affected Areas are also a good indication for employers undertaking risk assessments for workplaces above ground.

Q: What can I do if my property has high radon levels?

A: There are a number of techniques available to lower elevated radon levels including the installation/activation of a radon sump, installing positive ventilation or increasing underfloor ventilation. Costs will vary depending on the type of work required according to the radon level and the property construction. Further information on mitigation work is available at www.ukradon.org/information/reducelevels or www.bre.co.uk/radon.

Q: Is information available about radon in the workplace?

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

www.ukradon.org/sectors/employers

www.ukradon.org/sectors/householders

Additional advice on radon in the workplace can be found at
www.hse.gov.uk/radiation/ionising/radon.htm

Q: Is there any government funding for radon mitigation?

A: There is no funding available for radon mitigation work (to reduce radon levels). If you are a tenant, you should talk to your landlord.

Employers have a duty of care to ensure that employees have a safe working environment.

Useful contacts

For more information on radon in homes, contact NIEA on:

Industrial Pollution and Radiochemical Inspectorate (IPRI)
Northern Ireland Environment Agency
Klondyke Building
Cromac Avenue
Gasworks Business Park
Malone Lower
Belfast, BT7 2JA

UKHSA Centre for Radiation
Chemical and Environmental Hazards
Chilton, Didcot
Oxfordshire, OX11 0RQ
Tel: 01235 822622
Fax: 01235 833891
Email radon@UKHSA.gov.uk
Website www.UKradon.org

Geological Survey of Northern Ireland
Dundonald House
Upper Newtownards Road
Belfast, BT4 3SB
Tel: 028 9038 8462
Email gsni@economy-ni.gov.uk
Website www2.bgs.ac.uk/gsni/

Enquiries
British Geological Survey
Keyworth, Nottingham
NG12 5GG
Tel 0115 936 3143
Fax 0115 936 3276
Email enquiries@bgs.ac.uk
Website www.bgs.ac.uk

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

Licensing information

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All recipients of a licence (potential licensees) are required to return a signed digital data licence

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- allow a specified number of internal users to access/use the data (the number of users will be agreed with the licensee and specified in the licence document) for the purposes of their day-to-day internal activities
- reproduce extracts from the data up to A3 for use in external analogue (paper/hard copy) or non-query able electronic (e.g. secured .pdf) format: to meet a public task duty; fulfil a statutory requirement; and/or as part of academic or other non-commercial research

But **will not** be permitted to:

- provide a bureau service for others or incorporate the data in the generation of products or services for commercial purposes
- sell, assign, sublicense, rent, lend or otherwise transfer (any part of) the dataset(s) or the licence
- place (any part of) the dataset(s) on the Internet
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When the BGS digital datasets are revised any upgrades will be automatically supplied to the licensee, at no additional cost. The joint Radon Potential Dataset for Northern Ireland is revised on a periodic rather than on an annual basis, licensees will therefore not automatically receive a new dataset each year unless changes have been made to the data.

These are general comments for guidance only. A licensee of BGS's digital data is provided with full details of the basis on which individual BGS datasets licensed to them are supplied.

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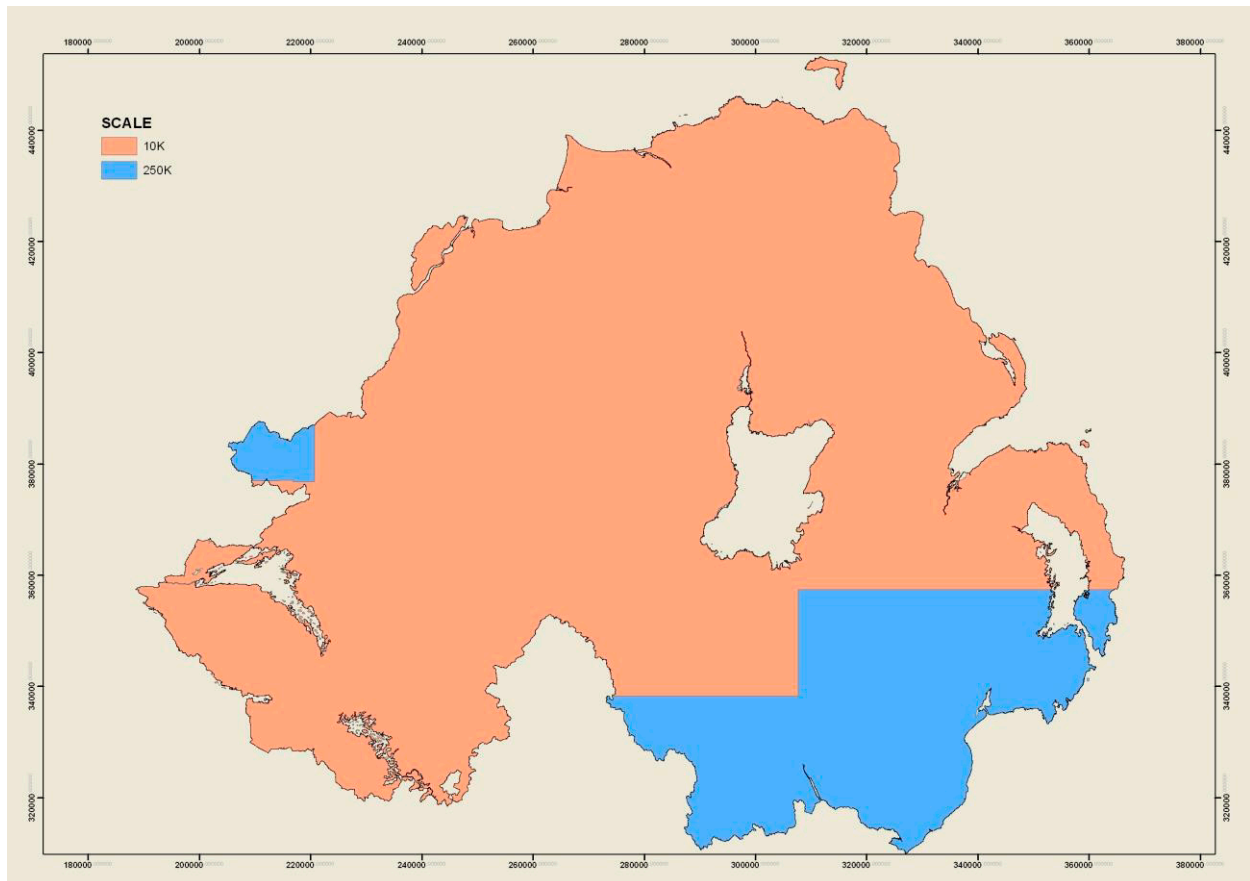
Appendix 1

Figure 7   Scale of geological data used to produce radon map.