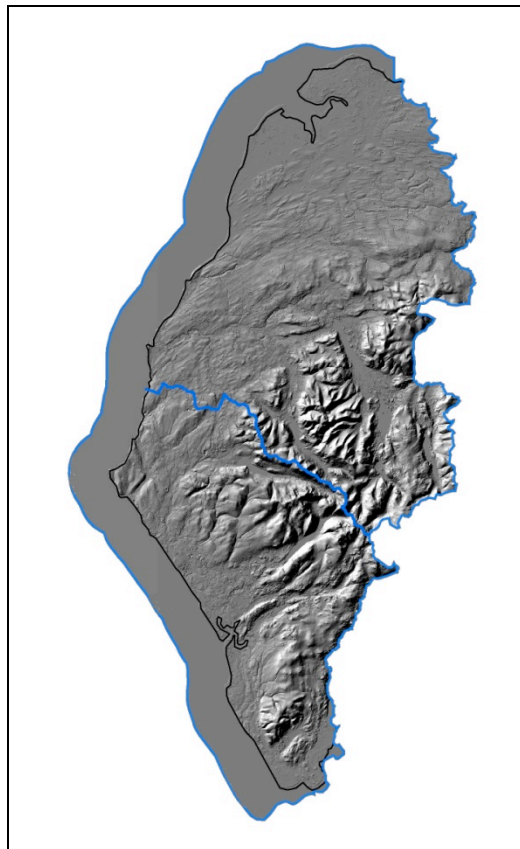




**British
Geological Survey**
NATURAL ENVIRONMENT RESEARCH COUNCIL

Managing Radioactive Waste Safely: Initial Geological Unsuitability Screening of West Cumbria: Non Technical Summary

Commissioned Report CR/10/072



Managing Radioactive Waste Safely: Initial Geological Unsuitability Screening of West Cumbria

Non Technical Summary

Background

In 2001 the UK Government began the Managing Radioactive Waste Safely¹(MRWS) programme with the aim of identifying a long-term solution for the UK's higher activity wastes that:

- achieved long-term protection of people and the environment
- did this in an open and transparent way that inspired public confidence
- was based on sound science, and
- ensured the effective use of public monies.

In 2003 the independent Committee on Radioactive Waste Management (CoRWM)² was established to consider the available options and make recommendations to Government. In October 2006, the Government accepted CoRWM's recommendations that geological disposal, preceded by safe and secure interim storage, was the best available approach. Government also accepted that an approach based on voluntarism, and partnership with local communities, was the best way of siting a geological disposal facility (GDF).

Geological disposal involves placing radioactive waste within engineered, multi-barrier facilities deep inside a suitable rock formation where the facility and geology provide a barrier against the escape of radioactivity. Internationally it is recognised as the preferred approach - it is being adopted in many countries including Canada, Finland, France and Sweden - and is supported by a number of UK learned societies including the Royal Society, the Geological Society and the Royal Society of Chemistry.

Following further consultation, the White Paper 'Managing Radioactive Waste Safely (MRWS): A Framework for Implementing Geological Disposal' was published in 2008; it sets out a staged approach to siting a geological disposal facility. The process starts with local communities initially 'expressing an interest' in opening up discussions with Government. At each stage, the process allows all those involved to take stock before deciding whether or not to move to the next stage at a particular site. Up until late in the process, when underground operations and construction are about to begin, the community has a Right of Withdrawal - if it wished to withdraw then its involvement in the process would stop. Figure 1, below, shows the main stages in the process.

The Nuclear Decommissioning Agency (NDA) have since published an additional document 'Geological Disposal: Steps towards implementation'³ which provides further information on what will be required for the successful implementation of geological disposal.

¹ <http://mrws.decc.gov.uk/>

² www.corwm.org.uk

³ www.nda.gov.uk/documents/upload/Geological-Disposal-Steps-Towards-Implementation-March-2010.pdf

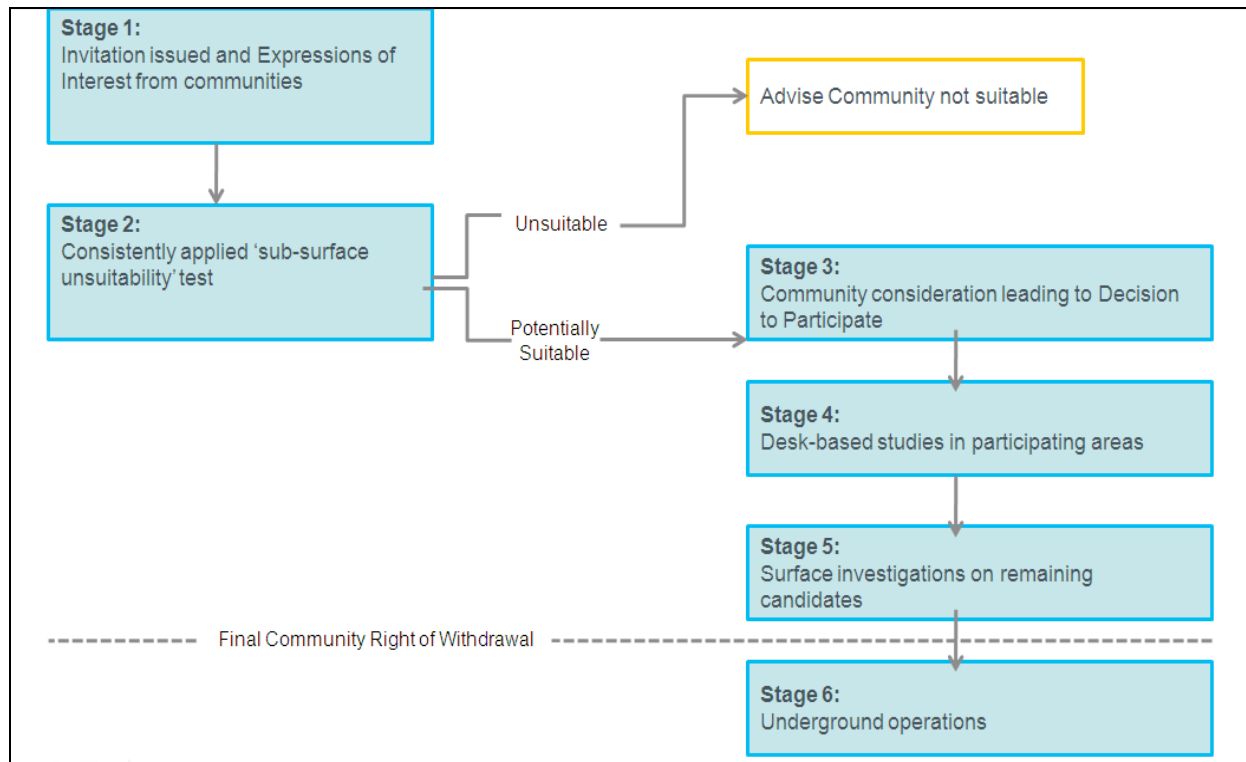


Figure 1. Stages in the site selection process (after Defra et al., 2008); this report addresses Stage 2.

Initial screening out of unsuitable areas

Following an expression of interest, the White Paper sets out the second stage, in which the British Geological Survey (BGS) undertakes a high level geological screening of the area using basic geological exclusion criteria that can be applied using existing knowledge. This screening is desk based, uses existing information and *will not* produce sites that could definitely host a facility, but will rule out areas that definitely could not host a facility for obvious geological reasons. At further stages of the site selection process increasingly detailed assessments would be made of any potential sites, applying more localised geological and other assessments. Areas which are ruled out in this initial sub-surface screening exercise might still be suitable locations for the surface facilities of a GDF.

Geological exclusion criteria

The geological exclusion criteria were derived during 2007 by two independent expert groups, each comprising of scientists with high calibre experience, and established following discussion and nominations from the Royal Society, the Geological Society and the Royal Academy of Engineering. One group (Criteria Proposals Group) proposed a suitable set of screening criteria and the other (Criteria Review Panel) then peer reviewed them to ensure that they were workable. The results were consulted on by Government in 2007 and the Chairs of both groups then reconsidered the criteria in light of the responses received before the final publication of the MRWS White Paper in 2008.

It is important to note that the exclusion criteria were derived to provide an initial 'first cut', solely to remove any obviously unsuitable geology from further consideration. The criteria could not be area specific and had to be suitable for application to *any* area of the country that 'expressed an interest'. The criteria need to recognise the early stage of the site selection process in which they are applied and, as such, have to be applicable across potentially large

geographical areas using existing information only. They are strictly geology based and, at this stage, they cannot consider detailed site-specific information such as local small scale geological features, the environmental impact of a facility, potential transport routes, population density, etc. Detailed examination and assessment of criteria based on these aspects will necessarily come later in the process if, and when, a community decides it wants to be involved further in the site selection process and actually begins to consider specific sites.

The final exclusion criteria agreed by the expert Chairs of the two groups are summarised⁴ in Table 1.

	To be applied as exclusion criteria?	Reasons/explanations and qualifying comments
Natural resources		
Coal	Yes	Intrusion risk to depth, only when resource at >100m depth
Oil and gas	Yes	Intrusion risk to depth, for known oil and gas fields
Oil shales	Yes	Intrusion risk to depth
Metal ores	Some ores	Intrusion risk only where mined at depths of >100m
Disposal of wastes/gas storage	Yes	Only where already committed or approved at >100m depth
Groundwater		
Aquifers	Yes	Where all or part of the geological disposal facility host rock is located within the aquifer
Shallow ⁵ permeable formations	Yes	Where all or part of the geological disposal facility host rock would be provided by permeable formations that might reasonably be exploited in the future
Specific complex hydro-geological environments	Yes	Deep karstic ⁶ formations and known source rocks for thermal springs

Table 1. Summary of initial sub-surface screening criteria

The final exclusion criteria are high level and largely based around two key issues - the need to exclude areas in order to reduce the risk of intrusion into a facility by future generations seeking to investigate and extract resources, and the need to protect the quality of exploitable groundwater.

The criteria groups also considered the case for and against a number of other geological exclusion criteria such as risk of earthquakes, geological faults, specific complex geological environments, erosion, etc. Following detailed consideration, the two expert groups concluded that these characteristics, although absolutely crucial in the investigation and

⁴ For the authoritative explanation of the exclusion criteria the CPG/CRP full advice and subsequent review document should be read. Available at http://mrws.decc.gov.uk/en/mrws/cms/Disposal/Site_selection/Initial_screen/Initial_screen.aspx

⁵ "Shallow", in this context, means less than 500 metres below the surface. Therefore, "deep" and "at depth" mean more than 500 metres below the surface.

⁶ Rock mass consisting of carbonate rocks (e.g. limestone) characterised by dissolution through the action of slightly acid surface and groundwater

assessment for a geological disposal facility, can only be properly considered later in the process at a site-specific level when more in-depth investigations can take place on the details of a particular site.

The initial geological unsuitability screening of west Cumbria

Since Government's call for communities to 'express an interest' in finding out more about the geological disposal siting process in 2008, three local authorities (Allerdale Borough Council, Copeland Borough Council and Cumbria County Council) have expressed an interest for the areas of Allerdale and Copeland.

The Councils have set up the West Cumbria Managing Radioactive Waste Safely (MRWS) Partnership⁷ to ensure that people living in the area are involved in making an informed decision about whether or not to proceed with the facility siting process. The Partnership includes a wide range of local organisations and, following initial public engagement, it was content for the Department of Energy and Climate Change (DECC) to commission the British Geological Survey to undertake the application of the sub-surface unsuitability test described above.

This work does not show where a facility might eventually be located. It is at an early stage in the site selection process and simply intends to avoid unnecessary work in areas which are clearly unsuitable for obvious geological reasons. A more rigorous assessment, based on a comprehensive range of criteria will only be undertaken if a 'decision to participate' in further stages of site selection process is taken.

The geological sub-surface screening report covers the known geology of Allerdale and Copeland and, at the request of DECC, an adjoining area 5 km offshore. The report considers areas that have clearly unsuitable geology for an underground geological disposal facility for radioactive waste, the depth of which is likely to be somewhere between 200 and 1000 metres below ground surface, but this will depend on the geology at the site in question.

This initial screening out exercise and report is based on the analysis of existing records, reports, BGS 'memoirs' and maps, and relevant published scientific literature on the geology of the Partnership area in relation to the recommended high level, sub-surface geological screening (or 'exclusion') criteria (Table 1).

The Partnership area has a varied geology including formerly worked mineral resources (e.g. coal and metal ores) and some exploitable groundwater resources. A general account of the geology and hydrogeology of the Partnership area is illustrated with simplified geological maps and cross-sections in order to provide a background for the non-geologist. The sub-surface screening criteria have been systematically applied to the geology and hydrogeology of the West Cumbria Partnership area and are discussed in detail. Figure 2 summarises the outcome of the sub-surface screening exercise and shows the areas that are screened out ('exclusion areas') where one or more of the exclusion criteria apply to the whole rock volume between 200 m and 1000 m depth.

Natural resources exclusion criteria (Table 1) most relevant to the Partnership area comprise: (a) coal and coal-bed methane (intrusion risk to depth), (b) oil and gas (intrusion risk to depth), and (c) metalliferous ores (where mined at greater than 100 m depth).

Areas known to be underlain by coal and hematite (iron) ore at greater than 100 m depth are screened out. These areas (Figure 2) comprise parts of the Partnership area extending north-west from Egremont and Whitehaven to Wigton and the Solway coast, and a small area near

⁷ www.westcumbriamrws.org.uk

Millom. The areas represent sub-surface rock volumes where there is a potential risk of inadvertent intrusion into a geological repository by future generations seeking to investigate and extract resources. Other metalliferous ores have been historically worked in the Partnership area, but these lie at shallow depths, less than 100 m, and the areas are not excluded.

Exploration for oil and gas ('conventional hydrocarbons') has taken place in the north of the Partnership area, but no resources have been proved. Consequently, although a part of north Allerdale is currently licenced for oil and gas exploration, the area has not been screened out at this stage since it does not represent a known oil and gas field. Similarly, gas derived from thick beds of organic-rich shales (known as 'shale gas') has not been proved in the Partnership area. Minor amounts of oil have been reported historically from coal-bearing rocks, which are excluded at depth (see above), but there are no known potentially exploitable oil shales resources in the Partnership area. There are no committed or approved areas (rock volumes) for the disposal of waste/gas storage in the Partnership area.

Groundwater exclusion criteria (Table 1) have been applied to exploitable groundwater resources in aquifers (e.g. Sherwood Sandstone Group) and shallow permeable formations, as well as specific complex hydrogeological environments.

Some, but not all, of the rock volume in areas where aquifers and shallow permeable formations are present in the Partnership area are excluded. However, nowhere does the exploitable aquifer rock volume extend over the whole of the depth range between 200 m and 1000 m below ground level and, consequently, the total area is not excluded at this stage. The isolation of a GDF from exploitable water resources will be a major issue for providing the eventual suitability of any proposed GDF. These aquifer rock volumes will need to be considered in more detail at later stages in the MRWS process if, and when, a community decides it wants to be involved further in the site selection process and actually begins to consider specific sites.

From the information available there are no known specific complex hydrogeological environments such as deep karst (extending to hundreds of metres depth) or thermal springs in the Partnership area.

Increasingly detailed regional and site specific geological assessments and other studies will be required at later stages in the MRWS process to establish the potential suitability of any sub-surface areas (rock volumes) for a geological disposal facility. This initial report will provide a background to any potential future studies.

The report includes an extensive glossary of technical terms, together with the sources of information consulted. Information consulted in the report may be obtained via the BGS library service, subject to copyright legislation (contact libuser@bgs.ac.uk for details).

Bibliographical reference for the full report:

POWELL, J.H., WATERS, C.N., MILLWARD, D, and ROBINS, N.S. 2010. Managing Radioactive Waste Safely: Initial Geological Unsuitability Screening of West Cumbria. *British Geological Survey Research Report*, CR/10/072. 73pp.



Figure 2. The West Cumbria MRWS Partnership area showing areas screened out (exclusion areas) where one or more of the exclusion criteria apply to the whole rock volume between 200 m and 1000 m depth. The Excluded Area is shown overlain on the 1:1 m scale Ordnance Survey base map. All information other than the Excluded Area (shown in pink) and the boundaries of the screened area (shown in blue) is taken from the Ordnance Survey base map and is shown for context only. Dashed blue line indicates the Allerdale-Copeland boundary. Topographical base is OS topography © Crown Copyright. All rights reserved. 100017897/2010.