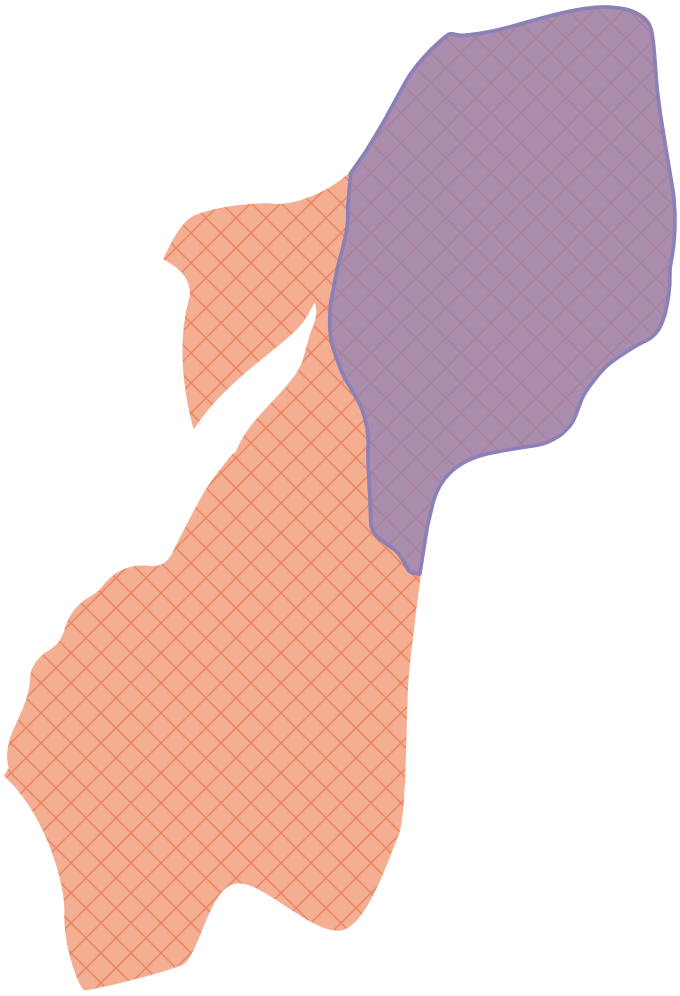
Radioactive Waste Management



Bristol and Gloucester

SUBREGION 1

Contents

Clicking on words in green, such as sedimentary or lava will take the reader to a brief non-technical explanation of that word in the Glossary section. By clicking on the highlighted word in the Glossary, the reader will be taken back to the page they were on.

Clicking on words in blue, such as Higher Strength Rock or groundwater will take the reader to a brief talking head video or animation providing a non-technical explanation.

For the purposes of this work the BGS only used data which was publicly available at the end of February 2016. The one exception to this was the extent of Oil and Gas Authority licensing which was updated to include data to the end of June 2018.

Our work shows that we may find a suitable geological setting for a GDF in most of this subregion.

Rock can be seen at the surface in some of the subregion such as the cliffs along the western edge of the Cotswolds and in man-made excavations such as quarries or road cuttings. Combined with some deep boreholes and geophysical investigations, this gives us an understanding of the rocks present and their distribution.

There are clay-rich rock layers under the whole subregion in which we may be able to site a GDF. We would need to do more work to find out whether these rocks have suitable properties and thicknesses.

Even where individual clay-rich rock layers are found not to be thick enough to host a GDF they may support the siting of a GDF in deeper rocks as they could act as a barrier to groundwater flow from depth. This is important because movement of groundwater is one of the ways in which radioactive material could be carried back to the surface.

There are no known coal, oil, gas or metal resources in this subregion which means that it is unlikely that future generations may disturb a facility.

Introduction

Bristol and Gloucester subregion 1 extends from Evesham in the north to near the M4 motorway in the south, and from Stow-on-the-Wold in the east to Gloucester in the west.

Rock type

Figure 1 shows where in the subregion there are likely to be Lower Strength Sedimentary Rocks (LSSR) within the depth range of interest. There are no Higher Strength Rocks (HSR) or Evaporites in the subregion. There are 2 LSSR within the depth range of interest:

- The Lias Group is several hundreds of metres thick within the depth range of interest, in the central part of the subregion, where it was deposited in a deep fault-bounded basin. The Lias Group comprises mudstones interlayered with limestones, siltstones and sandstones. It is unlikely that individual mudstones are thick enough to act as a host rock, but the Lias Group provides an effective barrier to vertical movement separating deep and shallow groundwater.
- The Mercia Mudstone Group occurs beneath the Jurassic rocks in the east, where its base is below the depth range of interest, rising to occur at the surface toward the west. Like the overlying Lias Group, the Mercia Mudstone is thickest in the central part of the subregion reaching thicknesses up to 550m. It comprises mainly low-permeability reddish-brown mudstone with thin siltstones, although some sandstone beds are present. Sandstones become more important further south, around the Mendips. The thick, extensive mudstone units are known to act as a barrier to groundwater movement and may be thick enough to be potential LSSR host rocks. Evaporite layers are present in parts of the Mercia Mudstone Group, but in this subregion they comprise mainly sulphate minerals such as gypsum and anhydrite, which have little potential as Evaporite host rocks.

Subsurface engineering in mudstones can be challenging because they are relatively weak. Where these mudstones occur in the lower part of the depth range of interest the constructability of a GDF would be considered during the siting process.

A summary of the geological attributes of the Bristol and Gloucester region can be found here, including a simplified rock column showing the oldest and deepest rocks at the bottom, with progressively younger rock units towards the top.

Rock structure

There are few major faults in this subregion and no major folding (Figure 2). Faults may act as barriers to or pathways for groundwater movement, depending upon their characteristics, and these would need to be considered during the siting of a GDF [1].

Groundwater

There is very little information on groundwater in the depth range of interest for a GDF, 200 to 1,000m below NGS datum, although there is information on groundwater in aquifers above 200m. There are several principal aquifers within 400m of the surface in this subregion including the Sherwood Sandstone Group and the Great and Inferior Oolite limestone aquifers. These limestone aquifers are used for public water supply in the east of the subregion in the Cotswold Hills. The Sherwood Sandstone Group occurs at the surface to the west and north of this subregion and dips below the low permeability Mercia Mudstone Group within this subregion where it is not used as an aquifer. Groundwater from depths greater than 400m is unlikely to be suitable as drinking water anywhere in the UK [2].

The Lias and Mercia Mudstone Groups are likely to act as a barrier to groundwater movement between deep and shallow groundwater even where they are not thick enough to host a GDF.

Several springs in the Malvern Hills are exploited commercially and indicate passage of groundwater to the surface. Although the routes for groundwater flow to the surface are presently poorly understood, it may take place along the few major faults which are present in the subregion.

In the north-east of the subregion, near Stow-on-the-Wold, deep exploration boreholes may influence the connectivity between shallow and deep groundwater which would need to be considered during the siting process (see Figure 3). There are no thermal springs in this subregion to suggest rapid flow of deep groundwater to the surface.

Resources

There are no known deep geological resources in this subregion and therefore the likelihood of inadvertent human intrusion in the future is likely to be low.

Natural processes

Earthquakes and glaciations are unlikely to significantly affect the long-term safety of a GDF in the UK. Therefore, whilst a GDF would need to be sited and designed to take account of natural processes which may occur during its lifetime, they are not considered further as part of this screening exercise.

[1] Faults occur on a diverse range of scales, from centimetres to kilometres, and the subsurface is criss-crossed by networks of numerous individual faults. However our work includes only those faults identified by the BGS with throws (vertical offset) of 200m or more. This is because the data available to the BGS are not able to resolve all faults consistently, across all thirteen regions, with throws less than 200m. We recognize the potential importance of smaller scale faults to the integrity of a GDF and will need to survey them in detail as part of the site evaluation process.

[2] Water Framework Directive UK TAG. Defining and reporting on groundwater bodies, 2012.

Figure 1 The areas of the Bristol and Gloucester subregion 1 where Lower Strength Sedimentary Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

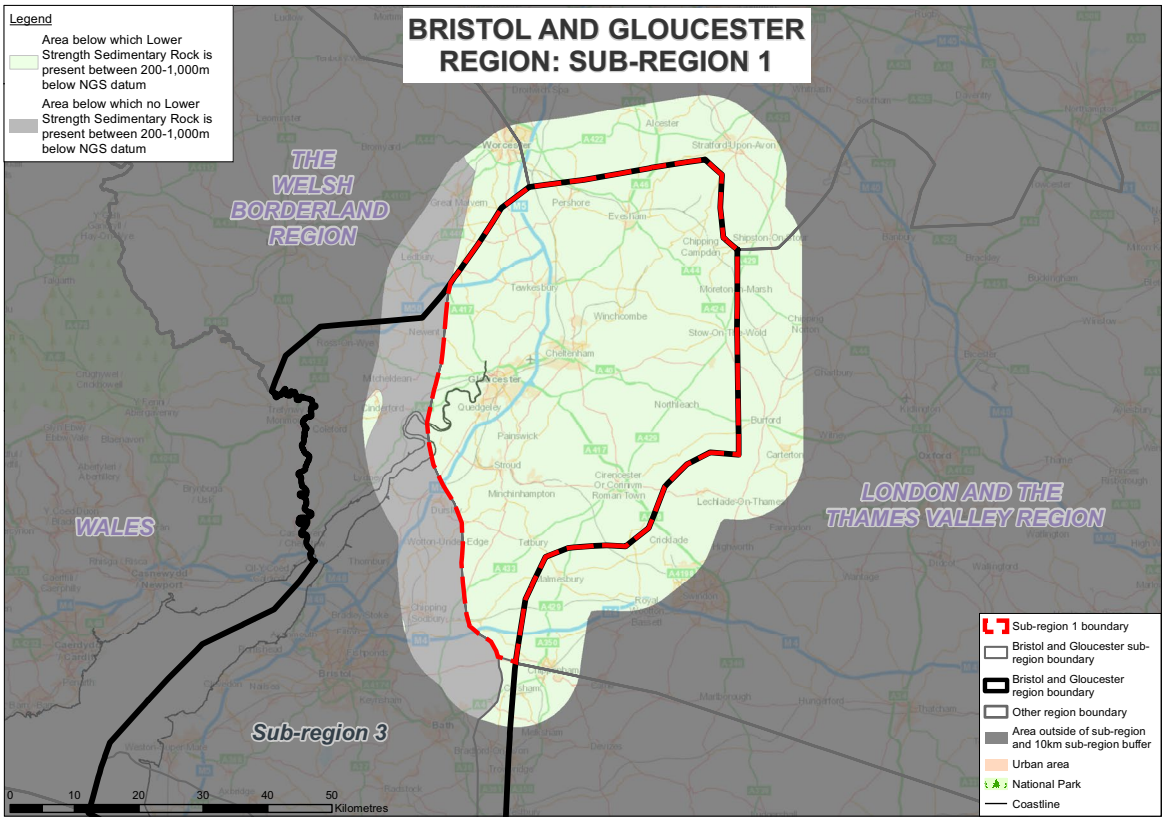


Figure 2 Location of major faults and folding in the Bristol and Gloucester subregion 1.

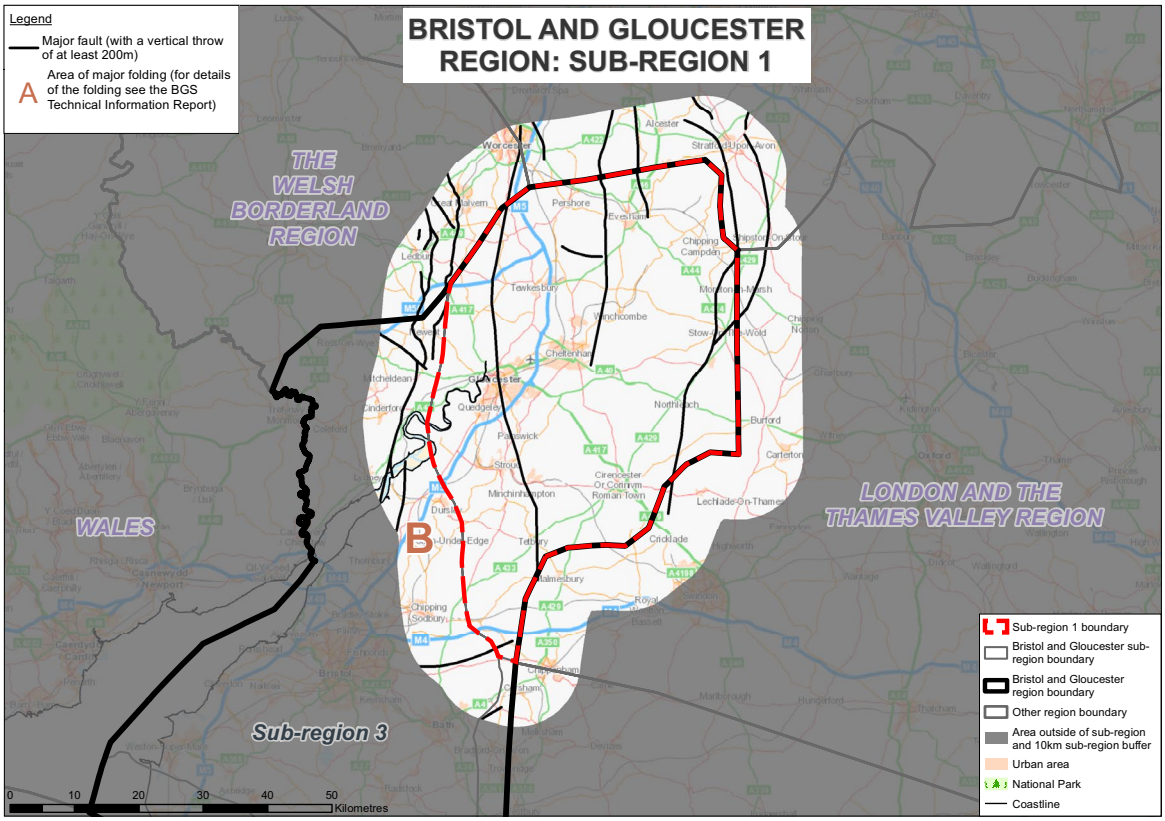
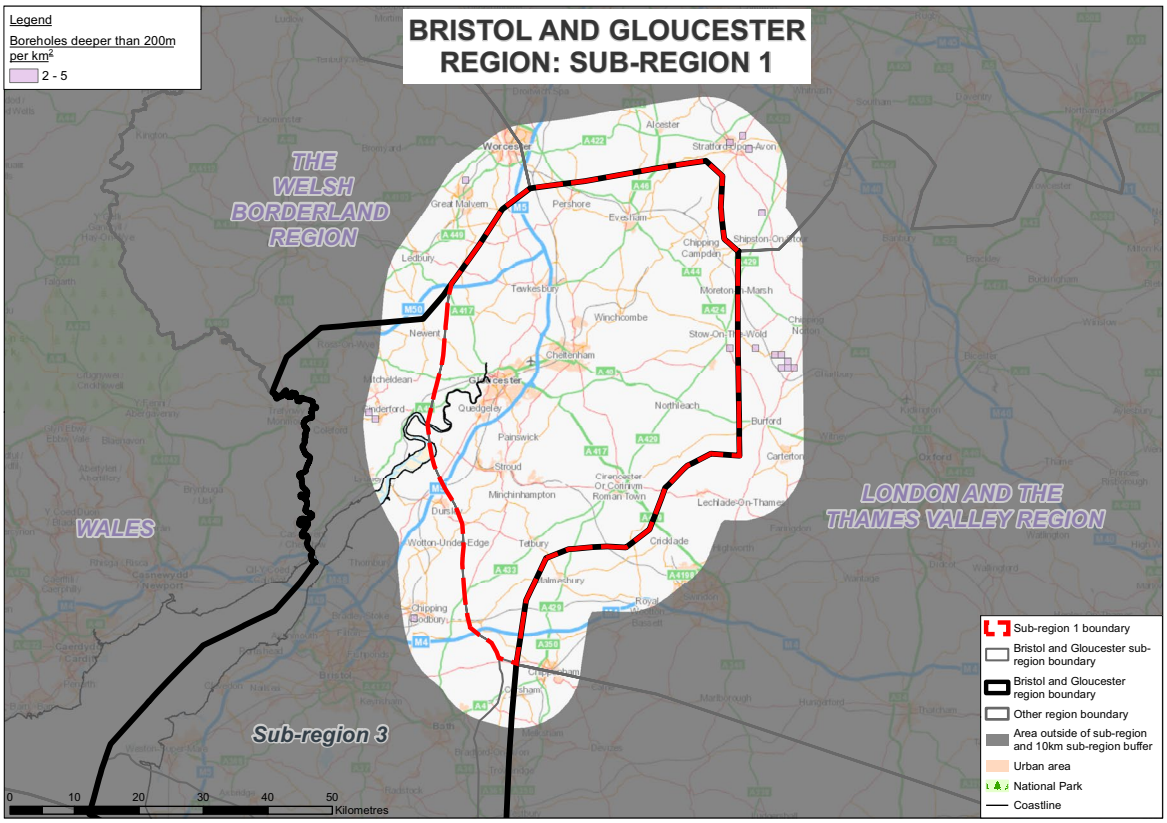


Figure 3 Areas in the Bristol and Gloucester subregion 1 with concentrations of deep exploration boreholes.



Glossary

Anhydrite
A calcium sulphate mineral that forms from the evaporation of salty seas. It contains no water and occurs at greater depths and higher temperatures than gypsum.

Aquifers
Aquifers are rocks that contain freshwater in pores and/or fractures and whose porosity and permeability are sufficiently high to make the extraction of groundwater possible.

Evaporite
The generic term for rock created by the evaporation of water from a salt-bearing solution, such as seawater, to form a solid crystalline structure. Gypsum, anhydrite and halite are all types of evaporite.

Fault
A fracture in the earth's crust across which the rock layers each side of it have been offset relative to one another.

Fault-bounded basin
A depression formed at the surface of the earth's crust which is located on the downthrown side of a fault. These depressions provide space for sequences of sedimentary rocks to accumulate.

Gypsum
A calcium sulphate mineral that forms from the evaporation of salty seas. It contains water and occurs at shallower depths and lower temperatures than anhydrite.

Principal aquifers
An aquifer classified by the Environment Agency as: "rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage." They represent the most important aquifers in terms of water supply or base flow.

Radioactive Waste Management

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