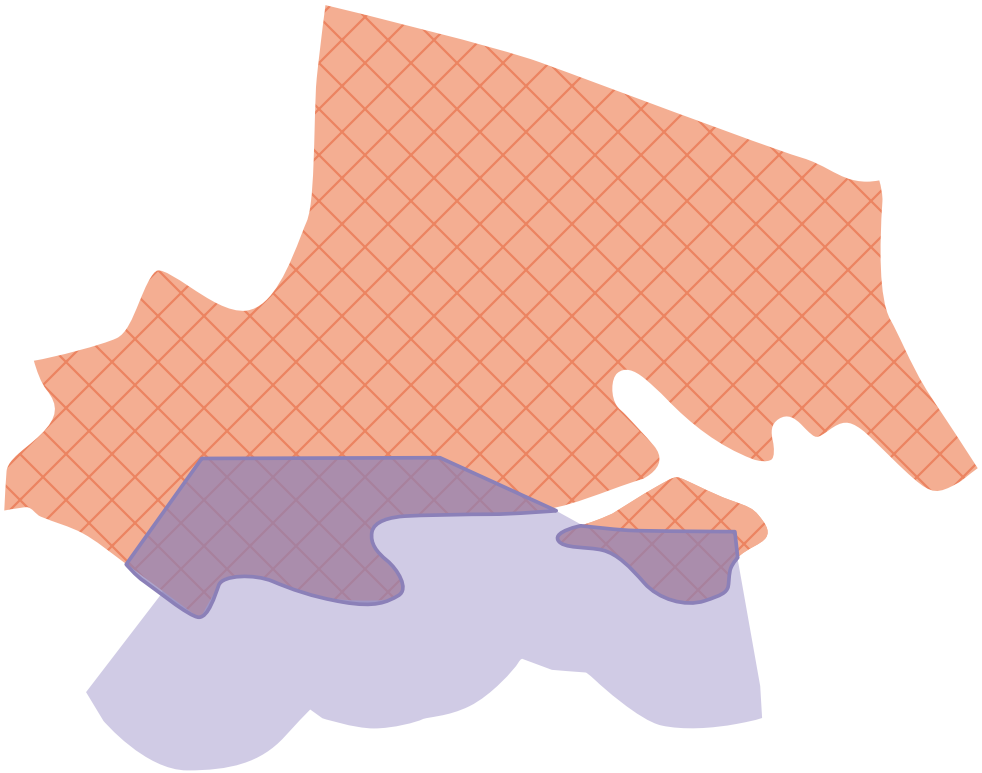
Radioactive Waste Management



Hampshire Basin

SUBREGION 3

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.

Half of the subregion is the inshore area which extends to 20km from the coast, but rock can be seen at the surface in the sea cliffs between Weymouth and Studland and man-made excavations such as quarries and road cuttings. Combined with numerous deep boreholes and geophysical investigations, particularly around the Poole Harbour area, 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 in the depth range of interest for a GDF.

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.

Some of the subregion, around Poole Harbour and Moreton to the east of Dorchester, has known oil resources. In these areas the drilling is likely to have affected the way in which water moves through the rock. Also possible exploration in the future in these areas means that it is more likely that future generations may disturb a facility.

Most of the onshore parts of this subregion and part of the inshore part between Poole Harbour and the Isle of Wight have Petroleum Exploration & Development Licences to allow companies to explore for oil and gas. This exploration is currently at an early stage and it is not known whether oil or gas in these licence areas will be exploited. RWM will continue to monitor how this exploration programme progresses.

Introduction

This subregion comprises the onshore area south of Dorchester and Wareham, the south-western half of the Isle of Wight and the inshore area extending to 20km from the coast between Abbotsbury and St Catherine's Point on the Isle of Wight.

Rock type

Figure 1 shows where in the subregion there are likely to be Lower Strength Sedimentary Rock (LSSR) layers within the depth range of interest. There are no Higher Strength Rocks (HSR) or Evaporites in the subregion. The geology of this subregion comprises a well-known and predictable sequence of younger sedimentary rocks throughout the depth range of interest. A number of LSSR layers, including the Wealden Group, Kimmeridge Clay and Oxford Clay Formations and Lias Group occur in the depth range of interest, predominantly in the lower few hundred metres. Subsurface engineering in mudstones can be challenging because they are relatively weak. Since 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 Hampshire Basin and adjoining areas 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

The subregion is affected by a series of east-west major faults (see Figure 2) that formed in the Carboniferous, but were reactivated during the early Cretaceous and, more spectacularly, during the Alpine mountain building episode. Best known among these is the Abbotsbury-Ridgeway-Purbeck-Isle of Wight fault structure, responsible for the spine of steeply tilted Chalk extending across the subregion from east to west, and associated folding such as the famous Stair Hole Crumple at Lulworth Cove. This fault structure complicates the distribution of the Rock Types of Interest throughout the centre of the subregion. It may also influence groundwater movement, particularly where there are steeply dipping layers and near vertical beds such as in the Purbeck Monocline. 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].

[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.

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. A number of principal aquifers are present in this subregion including the Chalk Group and are used for water supply where they occur within a few hundred meters of the surface. The layers of LSSR listed above are likely to provide hydraulic separation between deeper groundwater and the surface even where they are not thick enough to host a GDF. Groundwater from depths greater than 400m is unlikely to be suitable as drinking water anywhere in the UK [2].

There are several areas, such as around Wareham, where 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.

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

Resources

There are producing oilfields near Wareham, Kimmeridge (south-west of Corfe Castle) and Moreton (13km east of Dorchester); the Wytch Farm oilfield near Wareham is the largest onshore oilfield in the UK, extending off the coast as far east as roughly the midpoint between Poole Harbour and The Needles (Figure 4). In these areas the drilling is likely to have affected the way in which water moves through the rock. Also possible exploration in the future in these areas means that it is more likely that future generations may disturb a facility. These known resources would be taken into account in the siting of a GDF.

In addition, there are current Petroleum Exploration and Development Licences [3] for much of the onshore and some of the inshore part of this subregion (see Figure 4). It is not known whether oil or gas in these licence areas will be exploited but they would need to be considered during the siting process.

An underground gas storage facility was planned in rock salt layers under the Isle of Portland, having gained planning consent in 2008. It was to use caverns solution-mined in the Triassic Dorset Halite Member, which varies in depth across the subregion from around 300 to 400m, down to depths of 2.4km in the south and extending off the coast into the English Channel. Although it now seems unlikely that construction of this facility will proceed, in part because of the difficult technical aspects of the project and their effect on development costs, the potential for similar facilities in the future would need to be considered in the siting of a GDF. The rock salt layers extend off the coast into the adjacent inshore, but are likely to be deeper than 1,000m below NGS datum over much of this area.

The Hampshire Basin has been exploited for geothermal energy (at Marchwood near Southampton). Future licensing plans for geothermal energy would be considered in the siting of a GDF in this subregion.

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.

[3] This also includes other licences awarded by the Oil and Gas Authority to allow companies to explore for hydrocarbons.

Figure 1 The areas of the Hampshire Basin and adjoining areas subregion 3 where Lower Strength Sedimentary Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

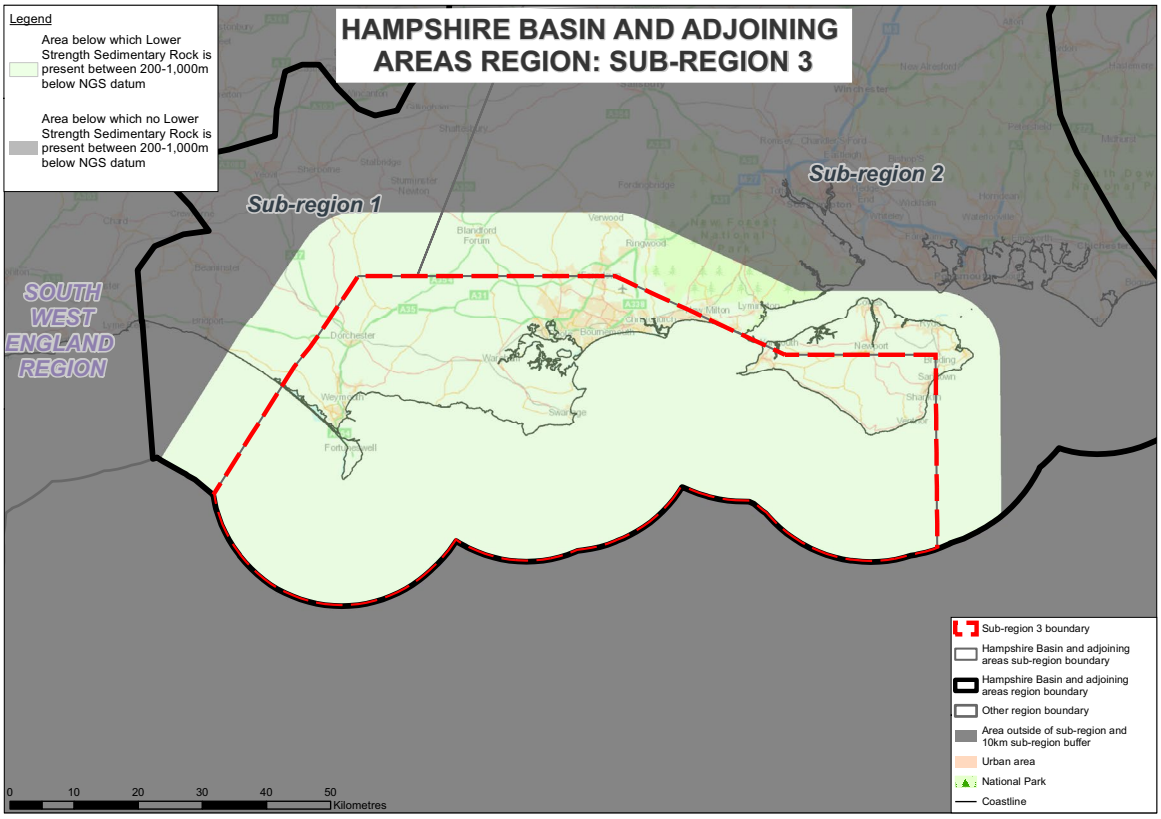


Figure 2 Location of major faults and folds in the Hampshire Basin and adjoining areas subregion 3.

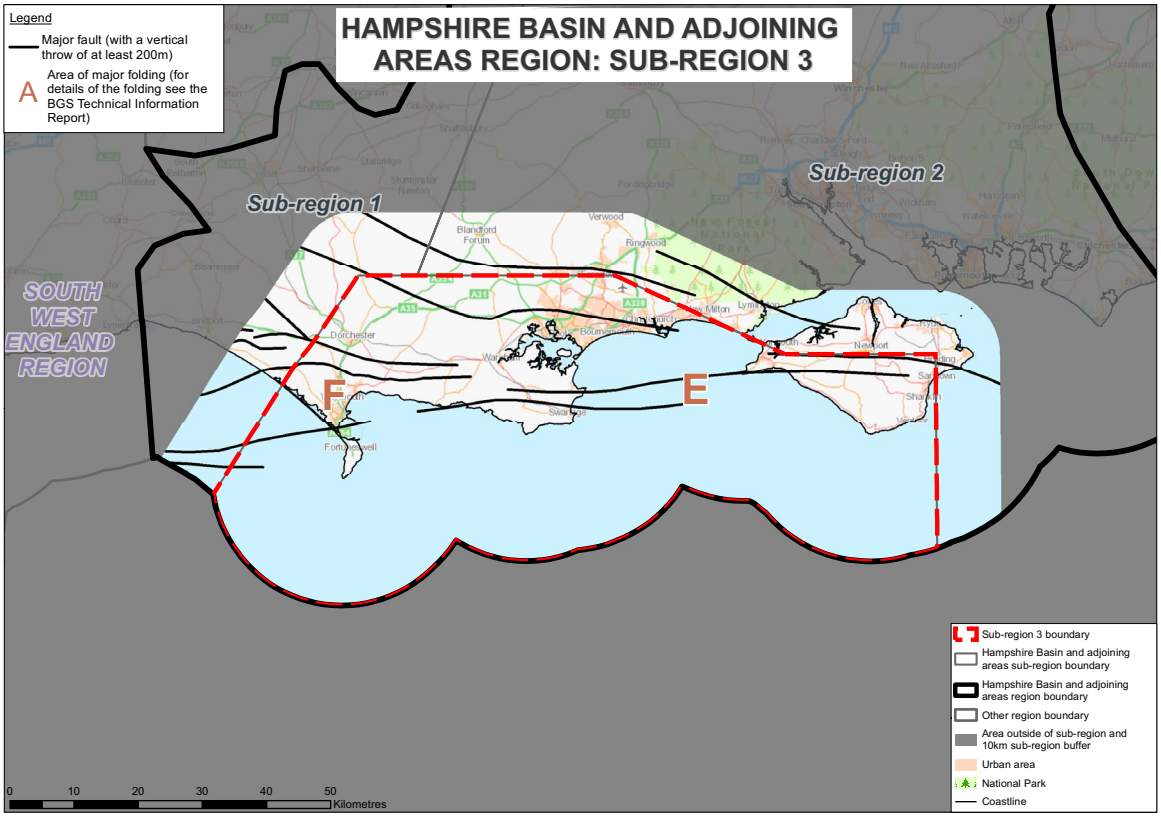


Figure 3 Areas in the Hampshire Basin and adjoining areas subregion 3 with concentrations of deep exploration boreholes.

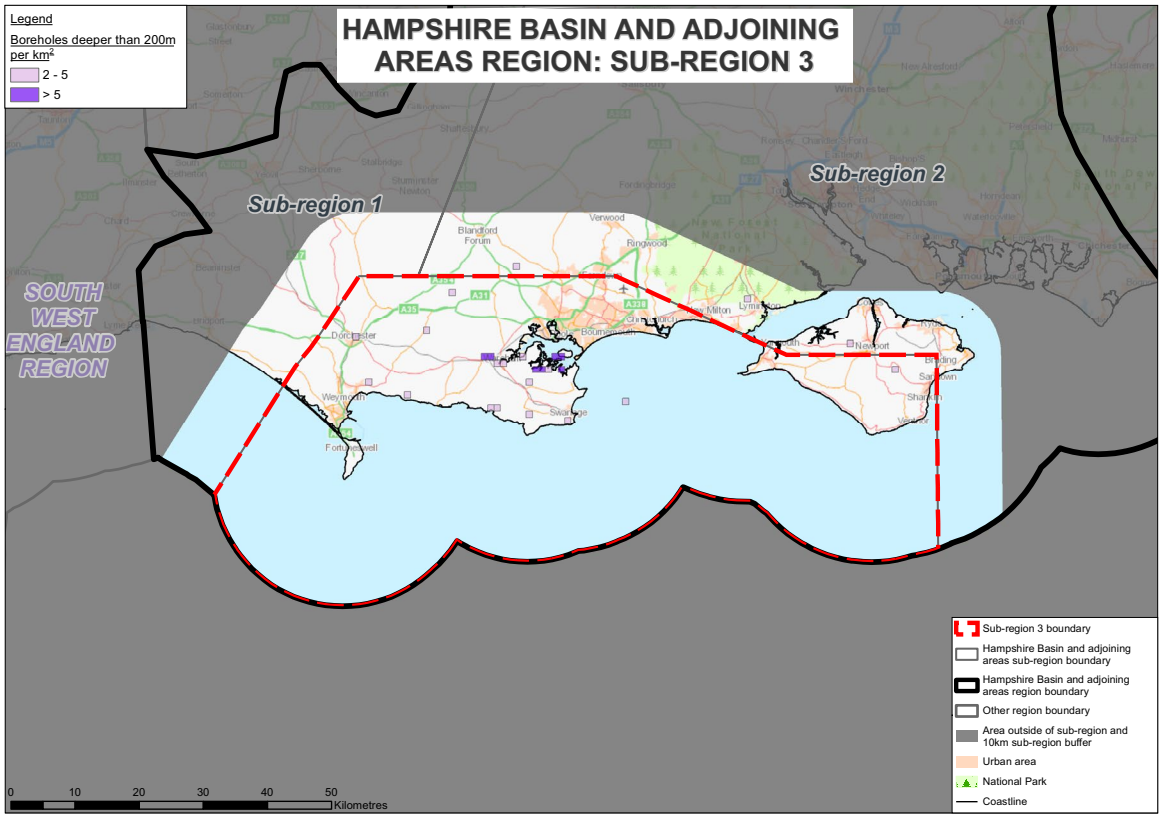
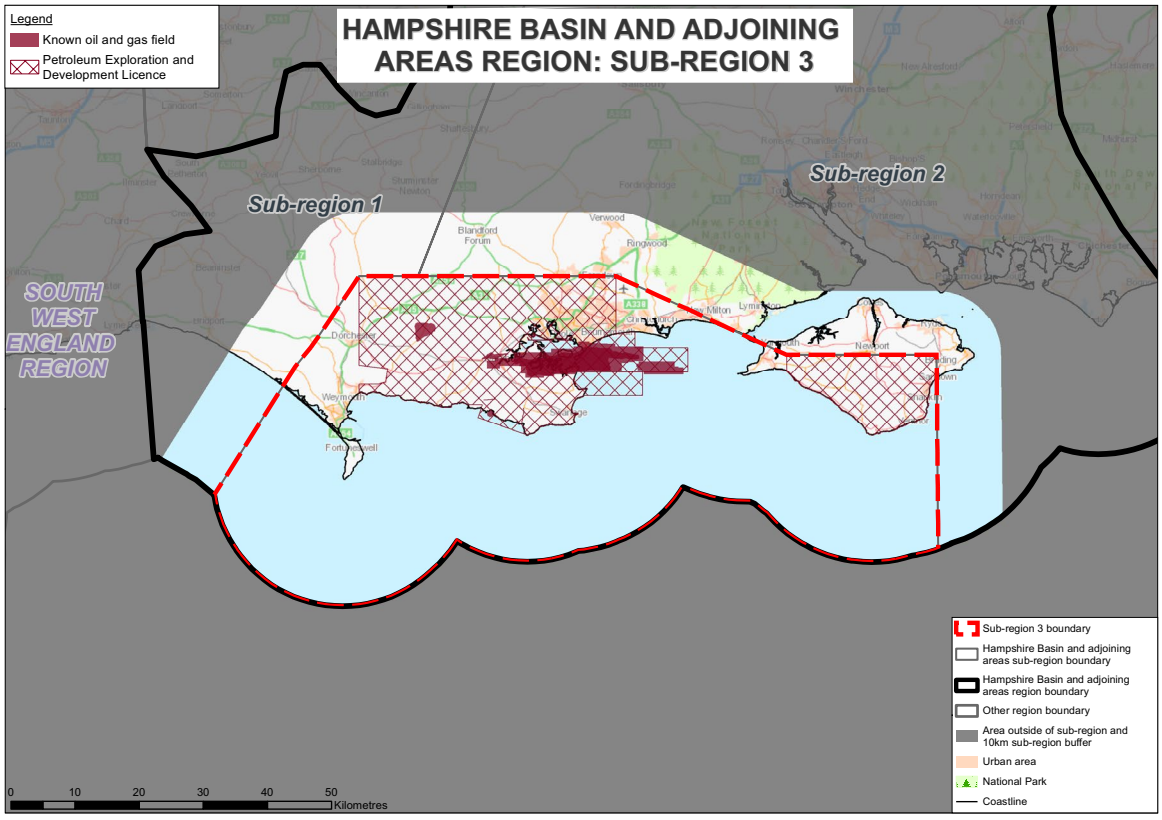


Figure 4 Areas of the Hampshire Basin and adjoining areas subregion 3 with oil and gas fields and Petroleum Exploration and Development Licences.



Glossary

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.

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

Gas storage facility
Underground facilities where gas can be pumped and stored under pressure. These can be within man-made caverns in salt deposits or by pumping gas into depleted oil and gas reservoirs. The gas can then be extracted again when demand is high.

Hydrocarbon
A compound of hydrogen and carbon. Hydrocarbons are the chief components of oil and natural gas.

Monocline
Step-shaped fold in layered rock strata.

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.

Solution mining
A technique to extract soluble minerals out of the ground by pumping liquids into a deposit, dissolving the target minerals, returning the water to surface and reprecipitating the mineral. Solution mining for rock salt is carried out in the UK and for other commercially valuable minerals around the world.

Radioactive Waste Management

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