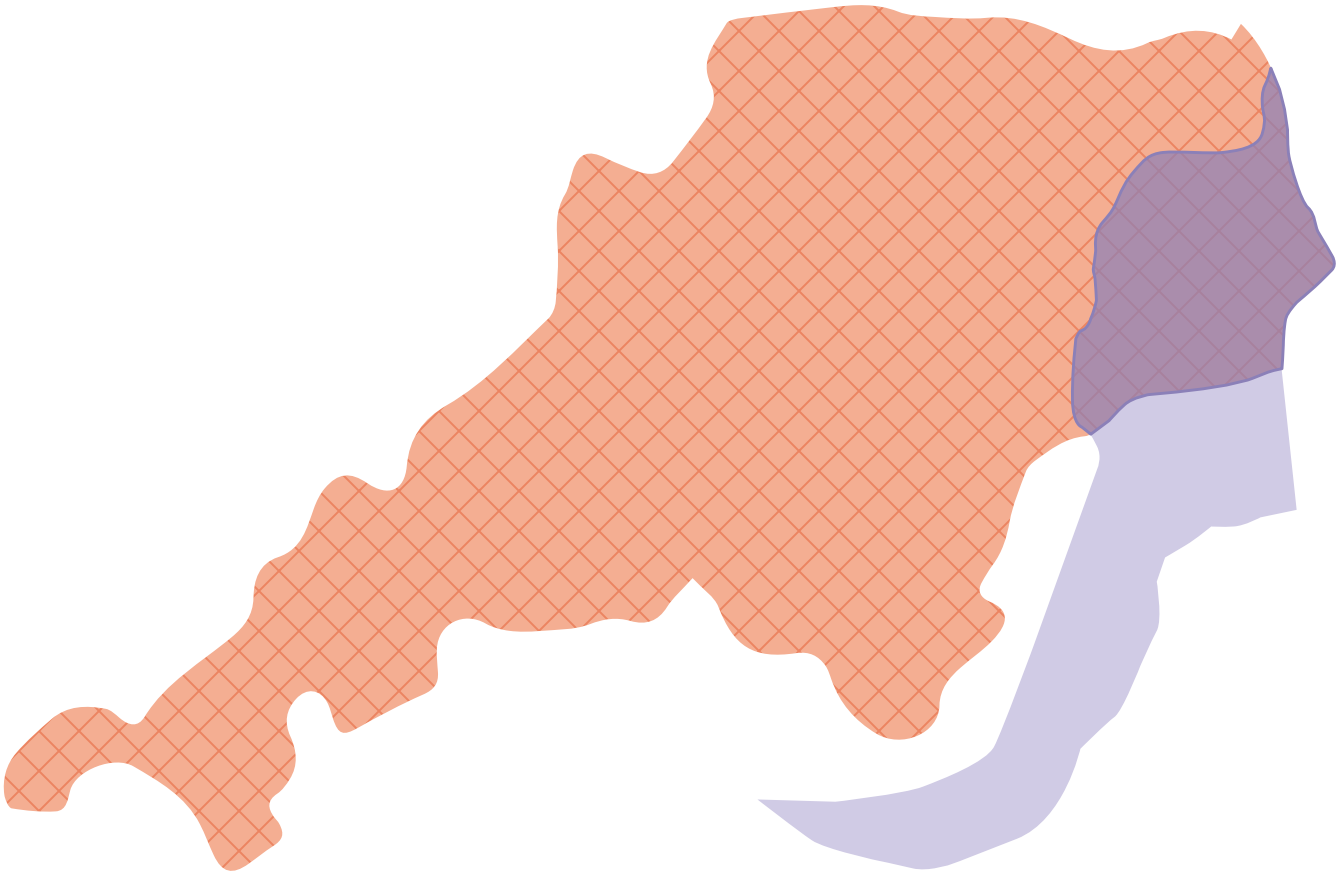
Radioactive Waste Management



South West England

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.

Given that the southern half of this subregion is the inshore which extends to 20km from the coast, rock can only be seen at the surface in the sea cliffs between Budleigh Salterton and Lyme Regis and man-made excavations such as quarries or road cuttings. A small number of boreholes and geophysical investigations give us an understanding of the geology at depth.

There are clay-rich rock layers under the whole of the subregion in which we may be able to site a GDF. There are also slates and similar strong rocks, around Taunton and off the coast of Budleigh Salterton, and layers of rock salt, between Lyme Regis and Chard, 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

This subregion comprises east Devon, approximately east of the M5 motorway and the River Exe estuary, and includes the adjacent inshore area which extends to 20km from the coast to the south-west across Torbay to Start Point.

Rock type

Figures 1a to 1d show where in the subregion there are likely to be Rock Types of Interest for the development of a GDF within the depth range of interest. The Lower Strength Sedimentary Rocks (LSSR) of interest in this subregion are part of the younger sedimentary cover:

- The Lias Group of Jurassic age (approx. 145 to 200 million years old) is present in the depth range of interest around Crewkerne. Off the coast, there is little information about the western extent of the Lias Group rocks. It contains mudstones interbedded with limestones. The individual mudstones are unlikely to be thick enough to act as a host rock, but the Lias Group is likely to provide effective hydraulic separation between deep and shallow groundwater.
- The Mercia Mudstone Group of Triassic age (approx. 200 to 250 million years old) occurs beneath the Jurassic rocks, where they are present, and is within the depth range of interest throughout this subregion. It is almost 500m thick at the eastern edge of the subregion near Crewkerne and is dominated by dolomitic mudstones and siltstones, with some minor sandstone units. Rock salt (halite) layers may be present to the north of Lyme Regis which may have the potential to act as Evaporite host rocks. The mudstone units are known to act as a barrier to groundwater movement and have the potential to act as LSSR host rocks, where they are sufficiently thick.

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 suitability of the rocks for GDF construction would be considered during the siting process.

There are a few areas along the western and northern boundaries of the subregion where basement rocks (older than 300 million years old) are present beneath the LSSR layers of the younger sedimentary rock sequence. The basement rocks here include mudrocks which have been folded and weakly metamorphosed to be slaty. However they are interbedded with other rocks of sedimentary origin including sandstones and further investigation would be needed to assess their potential as Higher Strength Rock hosts. The presence of overlying mudstones would contribute to the hydraulic separation of groundwater in the basement from the surface.

A summary of the geological attributes of the South West England 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 a small number of major faults affecting the younger sedimentary rocks 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].

The basement rocks are likely to be faulted and intensively folded throughout and this may impact on groundwater movement. It is also likely to complicate the search for a volume of rock with sufficiently uniform properties.

Groundwater

There is very little information available 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. In the onshore parts of the subregion, there are several principal aquifers within the younger sedimentary rock sequence. These include the Chalk and Upper Greensand in the east and the Sherwood Sandstone Group. These occur at the surface along the coast as far south-west as Paignton. There is some evidence in east Devon that where the sandstones are confined beneath mudstone layers, the rate of water movement through them is slow. Groundwater from depths greater than 400m is unlikely to be suitable as drinking water anywhere in the UK[2]. Where they are present off the coast the water present in the pores of rocks beneath the seabed is saltwater rather than fresh and they are not therefore suitable for use as aquifers.

It is likely that the LSSR layers act as barriers to vertical flow between the more permeable units described above and the surface or the seabed, even where they are not thick enough to host a GDF. There are no concentrations of deep exploration boreholes in this subregion and there are no thermal springs in this subregion to suggest rapid flow of deep groundwater to the surface.

Resources

There are no known resources in this subregion and therefore the likelihood of future human intrusion is considered 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 1a The areas of the South West England subregion 3 where any of the 3 Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

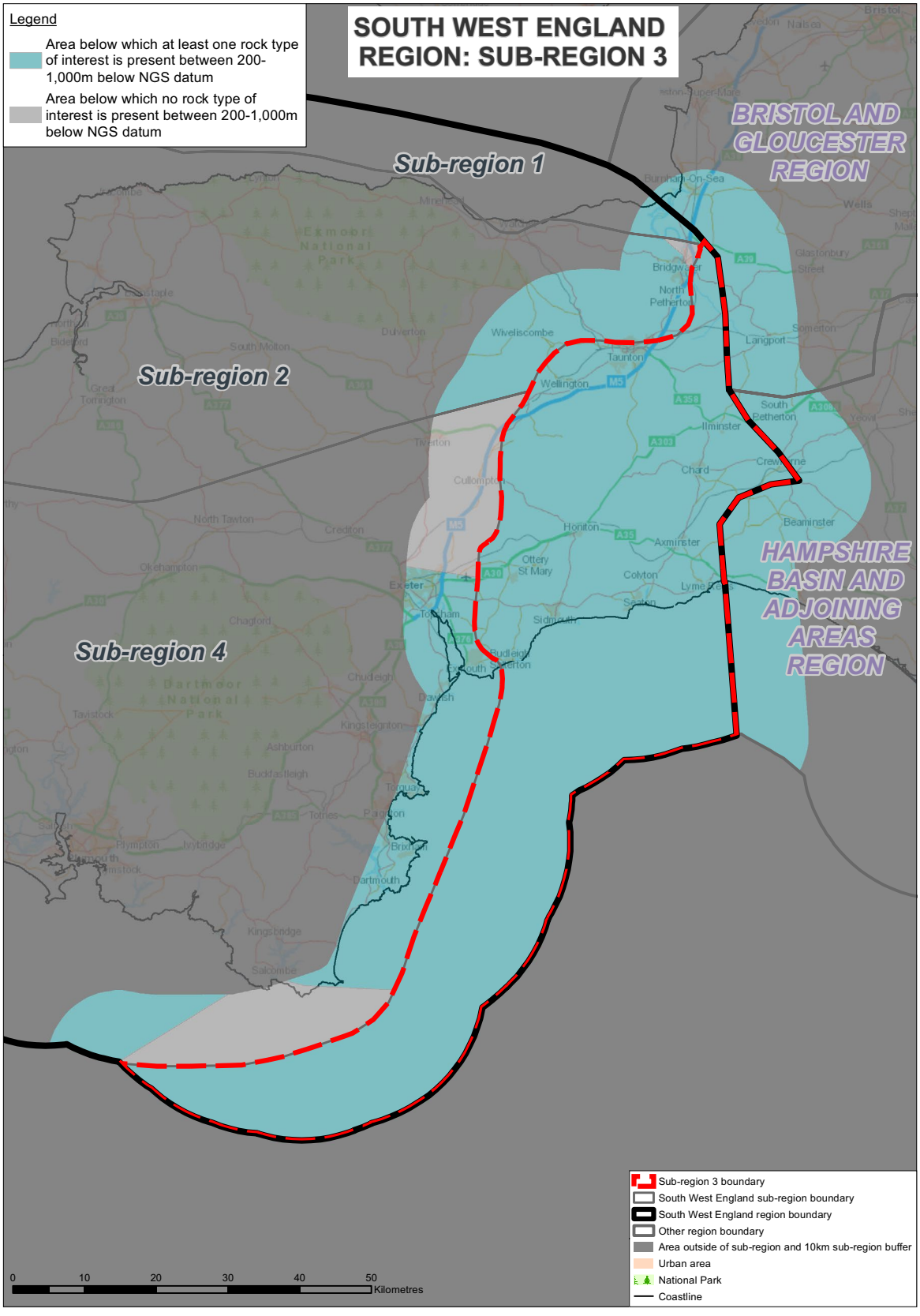


Figure 1b The areas of the South West England subregion 3 where Lower Strength Sedimentary Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

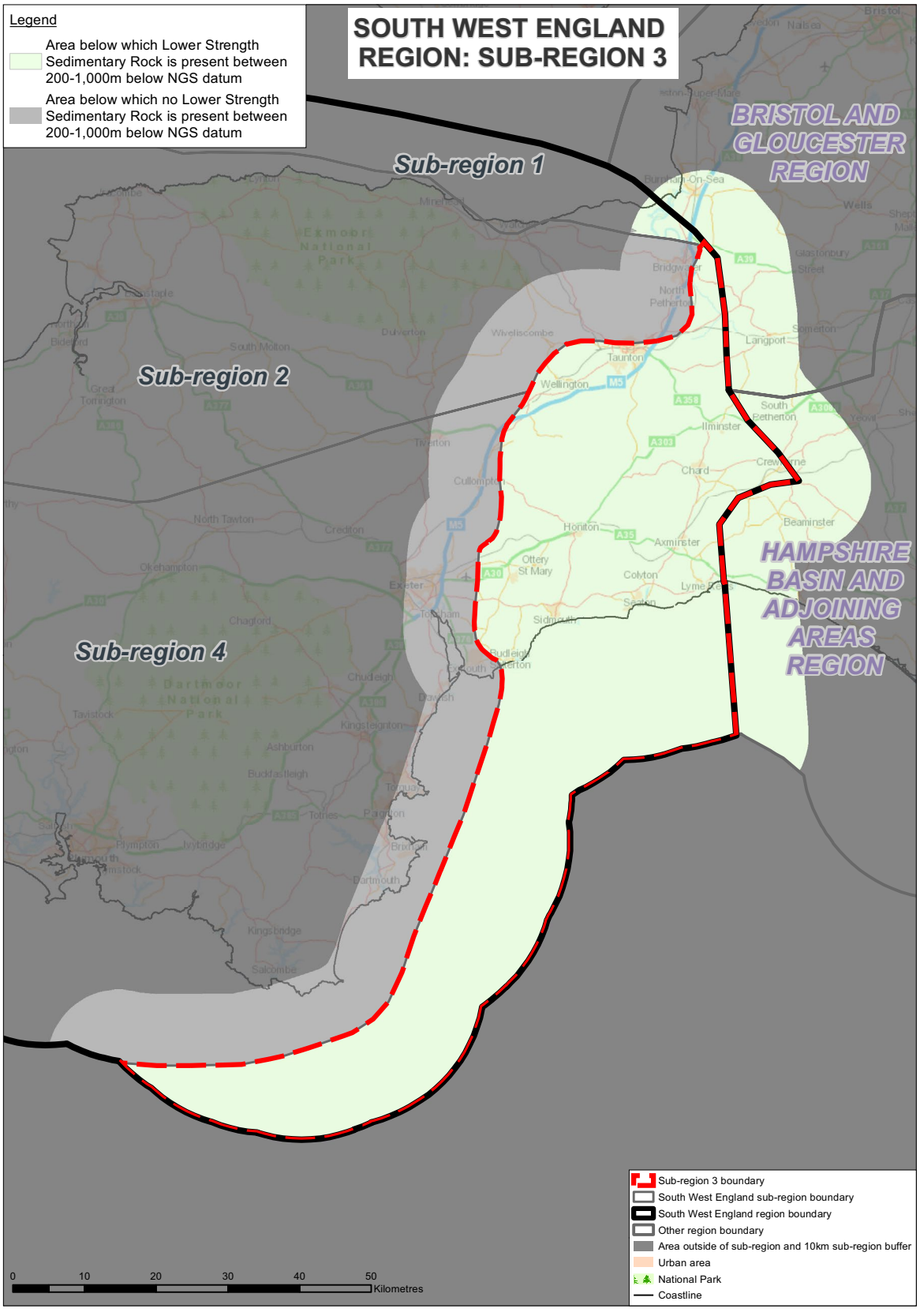


Figure 1c The areas of the South West England subregion 3 where Higher Strength Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

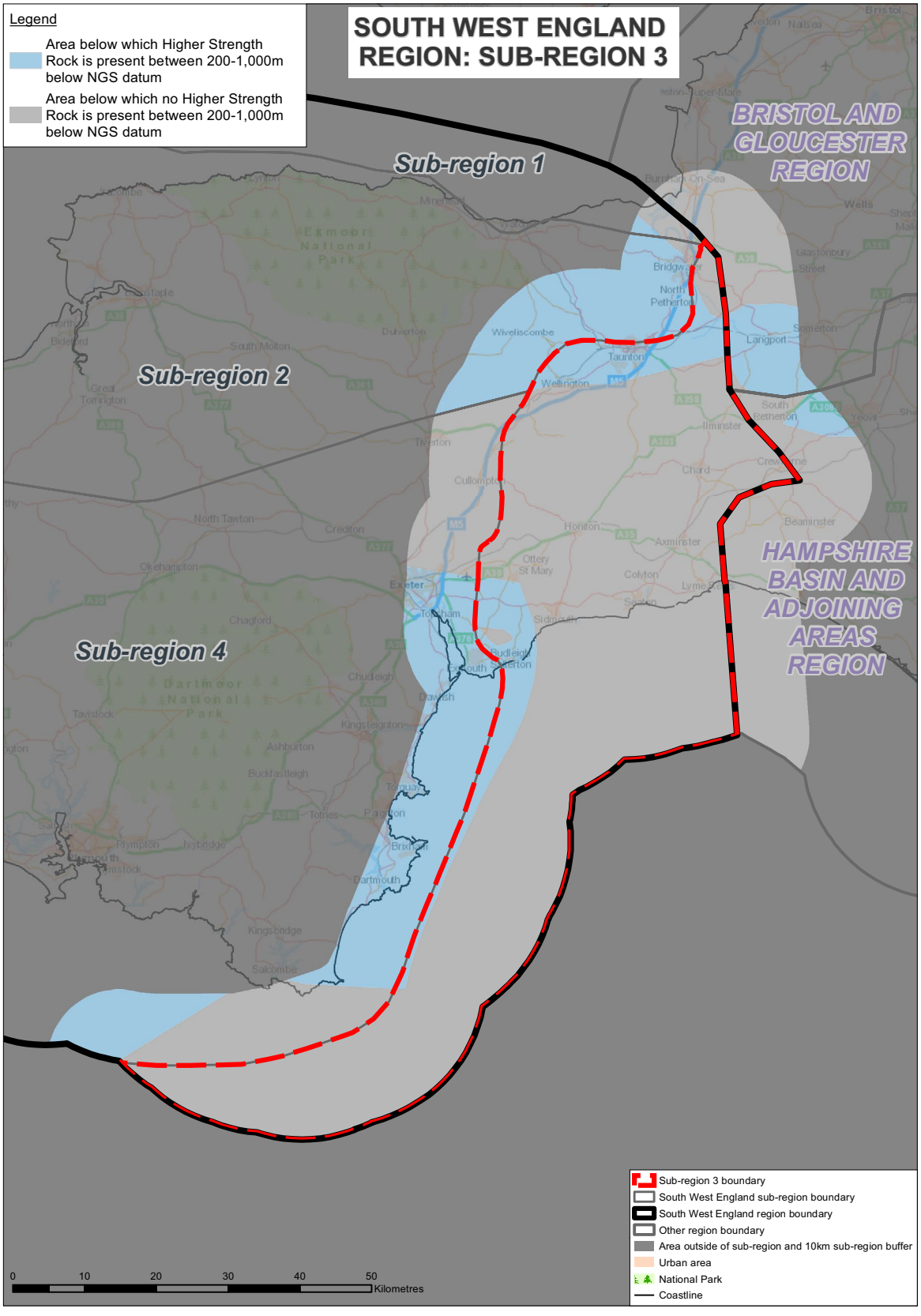


Figure 1d The areas of the South West England subregion 3 where Evaporite Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

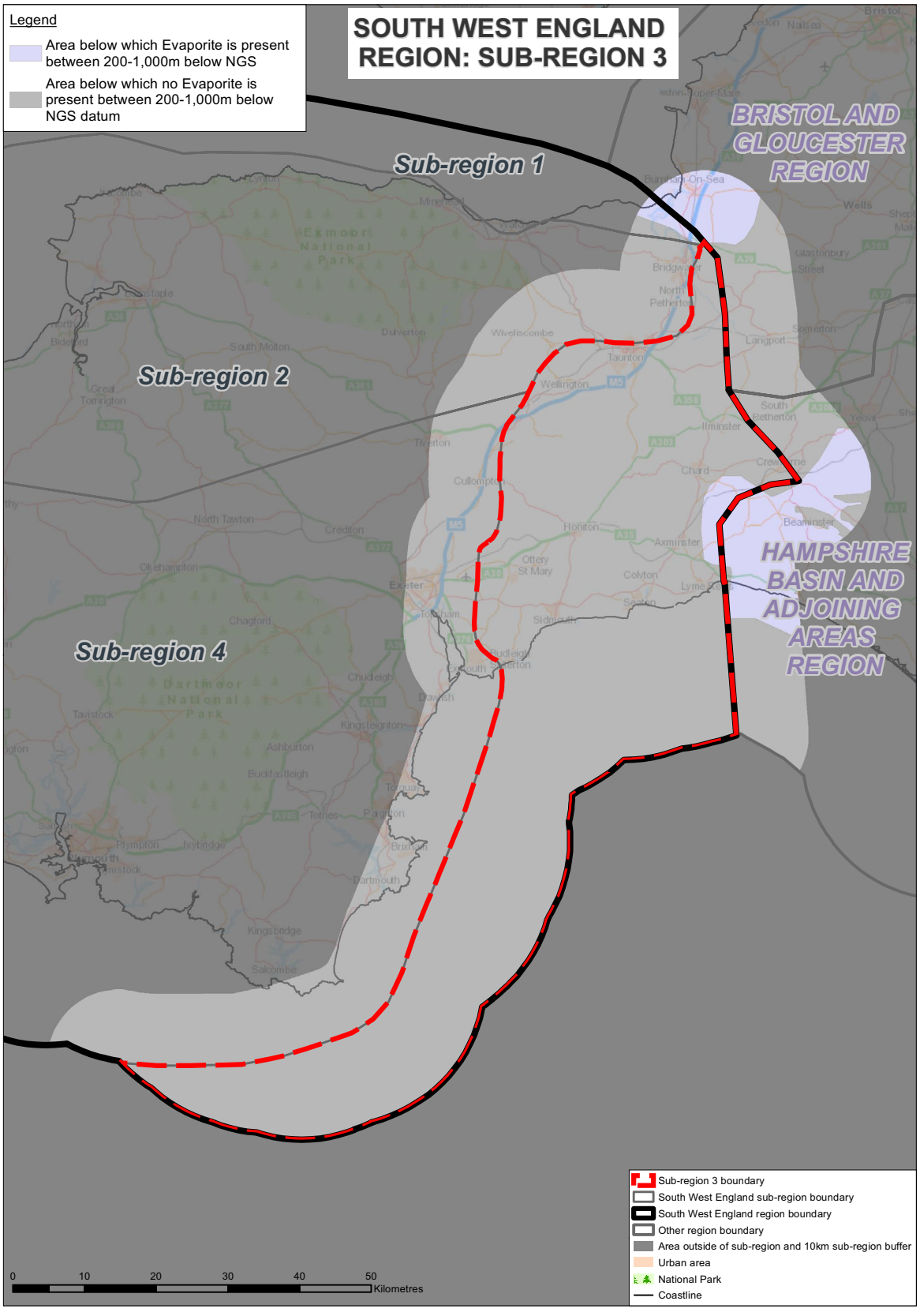
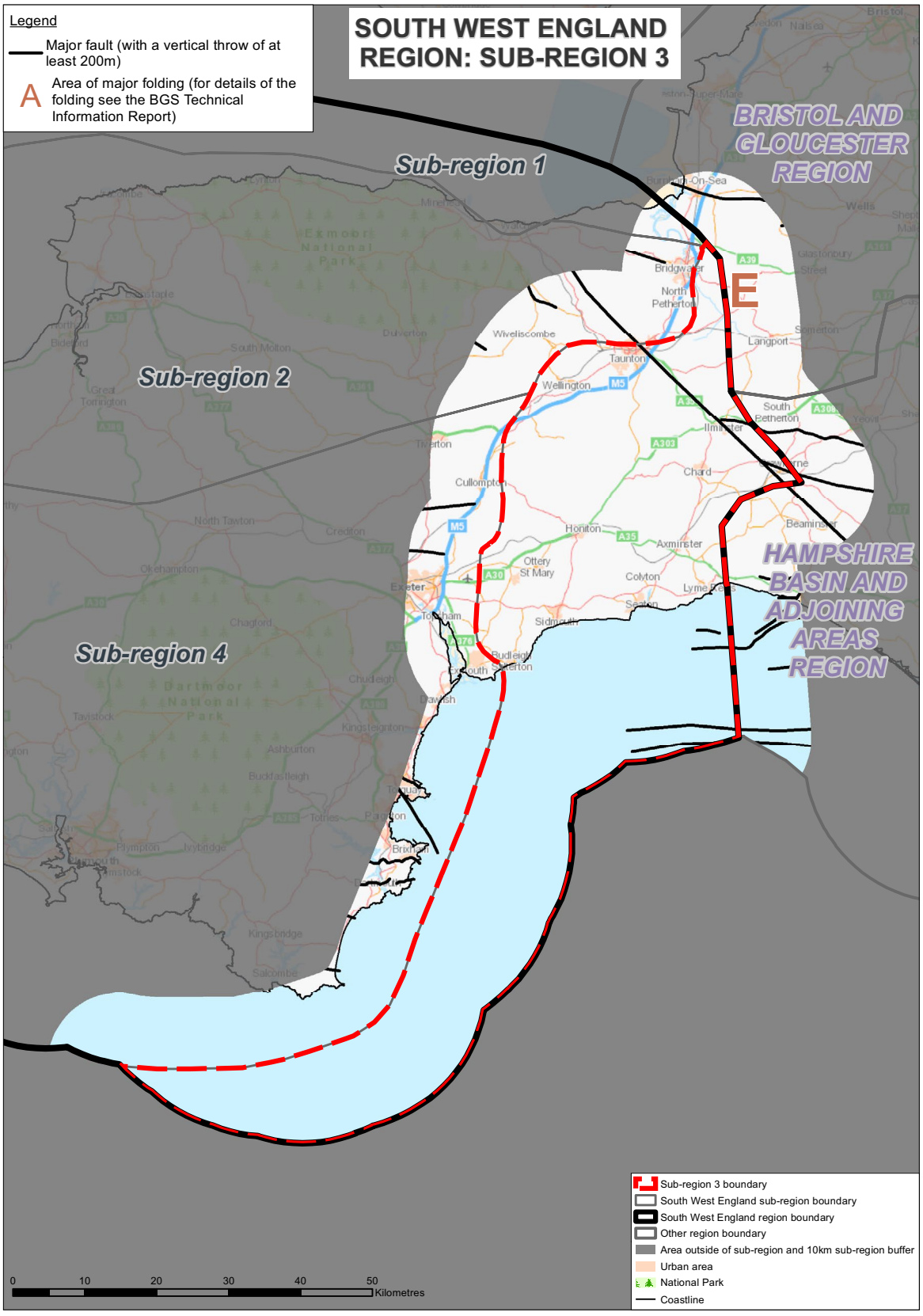


Figure 2 Location of major faults in South West England subregion 3.



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.

Halite
A sodium chloride evaporite mineral that forms when salty water dissolves. Also known as rock salt, or just 'salt'.

Metamorphosed
A rock that has undergone change due to the action of temperature and pressure.

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.

Sedimentary
A type of rock resulting from the consolidation of material that has accumulated in layers to form gravel, sandstone, mudstone and limestone. The layers may be built up by movement from erosion (e.g. by rivers, the sea or wind) or by chemical precipitation. Generally, the material that accumulates has originated from the weathering of other rocks. Sedimentary rocks constitute one of the three main classes of rocks identified by geologists, the others being igneous and metamorphic.

Slaty
Distinctive way in which slate rocks split into very fine sheets.

Radioactive Waste Management

Building 587
Curie Avenue
Harwell Oxford
Didcot OX11 0RH

T 03000 660100
www.gov.uk/rwm