TITLE: **The Sherwood Sandstone Group – Not Just a Big Red Sponge…**
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Introduction

The Sherwood Sandstone Group (SSG) is a major UK aquifer supporting public water supply, agriculture, and river flow across central and northern England. As climate-driven droughts increase, sustainable aquifer management is more critical than ever. New geological mapping and modelling by the British Geological Survey (BGS)—informed by advances in sedimentological and structural analysis—is helping to transform our understanding of the SSG. These insights are enabling hydrogeologists and other water sector professionals to better understand groundwater stores, predict groundwater movement, optimise recharge strategies and mitigate ecological impacts, all of which are essential for ensuring the long-term resilience of this vital aquifer and dependent ecosystems.

The Origin of the Sherwood Sandstone

During the Early Triassic period (~250 million years ago), the British Isles lay near the equator within the supercontinent Pangaea. Extensive river systems flowed across a hot, semi-arid desert, depositing both fluvial (river-transported) and aeolian (wind-blown) sands that would become the SSG.
These sediments became well cemented yet retained high porosity and permeability, making the SSG an exceptional aquifer. The rivers and dunes spread material across central and southern England, extending into what are now the East Irish Sea and North Sea basins—then dry land.
Tectonic activity has led to significant variation in SSG thickness. Around Nottingham, it is less than 100 metres thick, but in parts of Cheshire, it exceeds one kilometre. The West Midlands features a more diverse mix of aeolian and fluvial deposits, while the East Midlands is dominated by fluvial rocks. These differences influence groundwater storage and flow.
Overlying much of the SSG is the Mercia Mudstone Group, a generally impermeable unit. While it hampers recharge, it can also protect against surface contamination, creating complex recharge pathways and, in some areas, artesian conditions.

Aquifer Heterogeneity

The nature of the original depositional environment—whether aeolian (wind-blown) or fluvial—has a lasting impact on the SSG's hydrogeological properties.

- Aeolian sandstones, such as those present in the West Midlands, are typically relatively homogeneous and boast almost universally high porosity and permeabilities when undeformed. Analysis suggests permeability ranging from several hundred millidarcies to over 1 darcy (~1×10^{-12} to 1×10^{-11} m^2), making them excellent groundwater reservoirs by any standard.

- Fluvial sandstones, while still permeable, often contain more variable grain sizes, poorer sorting, and interbedded clay-rich layers. These features reduce pore connectivity, introduce anisotropy, and can act as barriers to flow.

Such homogeneity or heterogeneity can significantly affect both the yield and sustainability of water extraction from these strata. Regardless of whether the specific part of the SSG is of aeolian or fluvial origin, an understanding of how these units stack, pinch out, and connect is essential for predicting aquifer behaviour. Recent BGS mapping and modelling outputs, particularly in western England, have helped identify both high yielding and more restricted intervals in the region – With these insights providing the means to refine groundwater models and support abstraction strategies.

Added Complexity….

While depositional processes laid the foundation for the SSG's aquifer properties, post-depositional changes have added further complexity.

Over millions of years, the SSG has been subjected to tectonic forces that fractured and faulted the rock. These features are often assumed to enhance permeability by providing open conduits for flow. However, this is not universal; mineralisation and diagenesis can seal fractures, reducing permeability below that of the surrounding undeformed rock.

This complexity of fracturing both resulting in positive and negative permeability changes of the host rock is important to understand. One particularly challenging feature is the presence of deformation bands—thin, strain-localised zones that often form near major faults. These bands can reduce permeability by up to three orders of magnitude and can form complex geometries of interlocking planes, compartmentalising aquifers and significantly impeding groundwater flow.

Importantly, deformation bands and associated fault-damage zones (the areas surrounding larger faults) can extend tens to hundreds of metres away from the main fault trace—far beyond what is typically represented on geological maps, i.e. a single fault line. This has major implications for hydrogeological conceptual model development and modelling, as traditional fault representations may underestimate the true extent of the structural influence.

Specific to the West Midlands, BGS research has shown that aeolian units are more susceptible to deformation band development than fluvial ones, further complicating the hydrogeological picture. Identifying and characterising these features—often at scales to small for the resolution of conventional geophysical methods—requires a combination of fieldwork, borehole analysis and advanced modelling.

Effective aquifer management hinges on balancing abstraction with recharge and contribution to environmental flows, a task made increasingly complex by the natural heterogeneity of formations like the Sherwood Sandstone Group (SSG). By integrating detailed geological understanding—particularly of sedimentological and structural variability—with modern technologies such as remote sensing, GIS, and 3D groundwater modelling, we can significantly enhance our ability to manage this vital resource.

Tailoring Aquifer Management to Geology

Advances in BGS-led mapping and modelling are enabling more targeted aquifer management, especially in geologically complex or faulted regions. These tools complement traditional borehole tests by identifying zones of high permeability and areas where fractures may enhance or restrict flow.

Such insights support more effective and sustainable water resource strategies. For example, clean aeolian sandstones may offer high yields, while fractured zones may require careful monitoring. The SSG also faces water quality challenges, particularly in urban areas where it lies close to the surface. Cities like Liverpool, Manchester, and Birmingham sit atop the SSG, and legacy contamination from industry and ageing infrastructure poses a persistent threat. In Liverpool, elevated nitrate, potassium, and boron levels have been linked to leaking sewer systems. These contaminants exploit natural geological pathways, highlighting the importance of understanding subsurface structure when assessing pollution risk.

A detailed sedimentological perspective which includes superficial deposits, supported by BGS's full suite of tools—from borehole data, geological mapping to geochemical analysis—is essential for identifying low-permeability zones that may act as natural barriers or areas of pollution attenuation. This knowledge is critical for anticipating pollutant transport routes and informing both risk assessments and remediation strategies.

A Holistic, Resilient Approach

As climate change and population growth increase pressure on groundwater systems, the need for geology-informed decision-making becomes ever more urgent. The Sherwood Sandstone is just one geological unit whose aquifer properties could be better characterised by a more holistic approach—one that integrates sedimentology, structural geology, hydrogeology, and environmental monitoring—can support:

- Sustainable abstraction and recharge planning
- Improved water quality protection
- Resilience to climate variability and land-use change
- Regulatory compliance and long-term resource security

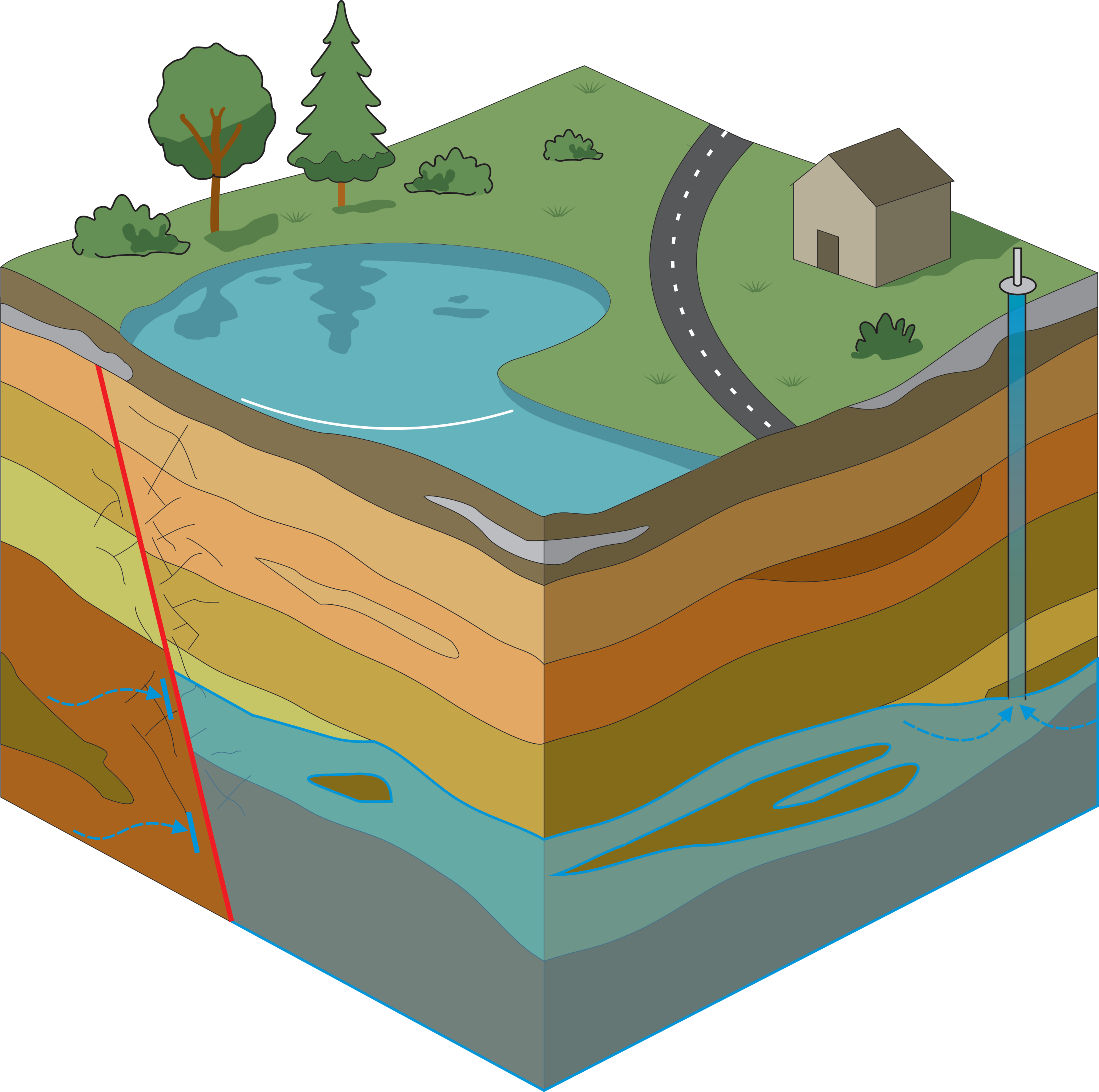
Geology at the Heart of Water Security

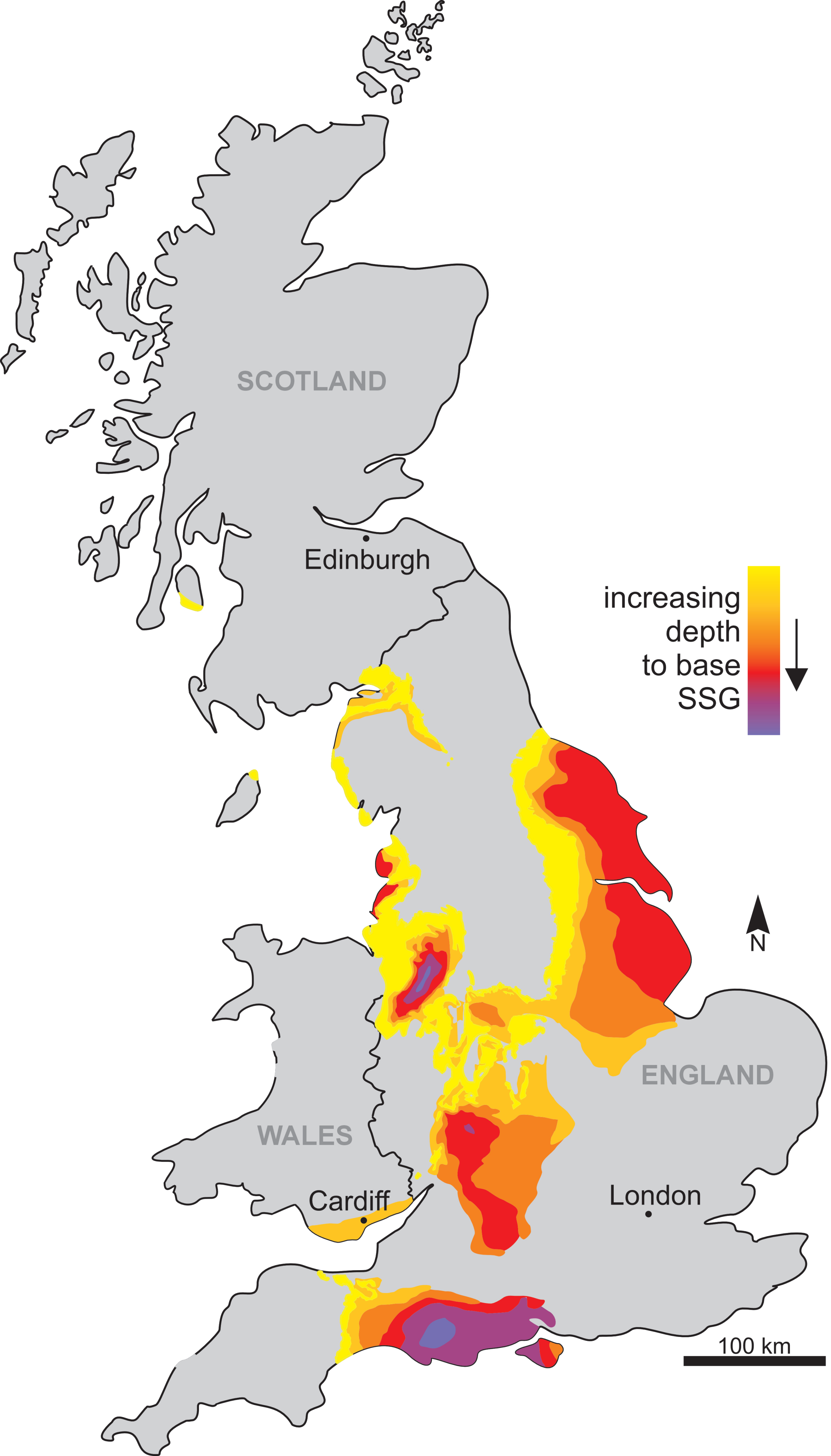
The Sherwood Sandstone Group is not just a “big red sponge”—it is a complex, dynamic, and regionally variable aquifer system. Effective management demands a deep understanding of its geological properties.
By applying multidisciplinary expertise, we can move toward more tailored, sustainable strategies that align with national water security goals. As demand for water intensifies, the geological character of our subsurface systems must remain central to securing our water future.

Collaboration between geologists, hydrogeologists, engineers, and policymakers will be key to unlocking the full value of the Sherwood Sandstone—and ensuring it continues to serve society for generations to come.

CAPTIONS:

1. **Sherwood_Map.jpg** – *Extent and depth of the Sherwood Sandstone across England*.
2. **Block_Model.jpg** – *Conceptual model showing subsurface complexity and its impact on water abstraction*.




SCOTLAND
Edinburgh
increasing depth to base SSG
N
ENGLAND
WALES
Cardiff
London
100 km