

# Hydrogeology of Wales: The Old Red Sandstone aquifer - groundwater occurrences

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**This page is part of a category of pages that provides an updated review of the occurrence of groundwater throughout Wales.**

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Although the Old Red Sandstone sequence approaches a thickness of 2 km in places, it offers little prospect for significant groundwater storage and transport. This is partly due to the interbedded weakly permeable mudstones, marls, and siltstones which tend to isolate the more permeable arenaceous sequences, inhibiting deep components of vertical flow. The channel-bottom calcrete deposits provide discreet zones of higher permeability and better prospects for groundwater transport. Nevertheless primary porosity is usually low, and the predominant groundwater-flow mechanism is via fractures.

Marls and siltstones predominate in the lowermost Old Red Sandstone strata. To these primary lithological controls are added the effects of poor sorting, frequent presence of micaceous material and induration arising from postdiagenetic compaction and burial. The primary porosity in some horizons of the Old Red Sandstone, for instance, is so low that they have long been used as flagstones. Associated cementation, both calcareous and siliceous, further decreases primary porosity, although this appears to be less the case in the Upper Old Red Sandstone, where the Quartz Conglomerate Group passes up into soft, poorly cemented fine- to coarse-grained sandstones (Holliday, 1986). In general however, the predominant Old Red Sandstone flow mechanism is via fractures, with much of the storage likely to occur in joint- and fault-related fracture systems.

Much of the strata are anisotropic and behave as a complex, multilayered aquifer with sandstone bands hydraulically isolated by interbedded mudstones, especially where there are no structural discontinuities. The effective saturated thickness, for most practical purposes, is only to about 40 m below ground surface, beneath which fracture dilation approaches zero. Steep regional hydraulic gradients of 0.01 to 0.1 reflect the low conductivity of the strata.

Summary of aquifer properties data for the Old Red Sandstone of Wales and the Welsh Borderland - includes four sites in Raglan Mudstone Formation see **Chapter 3** (after [Jones et al., 2000](#)).

	Value	Population
Number of borehole records		148
Transmissivity range	0.000001 to 350 (m <sup>2</sup> d <sup>-1</sup> )	
Mean transmissivity	51 (m <sup>2</sup> d <sup>-1</sup> )	66
Storage coefficient range	1.9 x 10 <sup>-4</sup> to 5.0 x 10 <sup>-2</sup>	3
Specific capacity range	0.000001 to 1226 (m <sup>3</sup> d <sup>-1</sup> m <sup>-1</sup> )	
Mean specific capacity	39 (m <sup>3</sup> d <sup>-1</sup> m <sup>-1</sup> )	135

The principal controls on permeability and transmissivity of the Old Red Sandstone are lateral and vertical heterogeneity arising from lithology changes, degree of induration/cementation, and extent/depth of fracturing along bedding planes, as joints or in association with faults or bed flexures. The range of transmissivity values available from pumping tests in the strata range up to

350 m<sup>2</sup> d<sup>-1</sup>, with a mean of 51 m<sup>2</sup> d<sup>-1</sup> (see **Aquifer properties table**). The few storativity values that are available indicate that semiconfined to unconfined conditions are predominant ([Jones et al., 2000](#)).

Nevertheless, the Devonian-age Old Red Sandstone is arguably the most important aquifer in Wales. The main outcrop of the aquifer contains at least 2650 abstractions and over 80 per cent of these are licensed for groundwater abstractions (i.e. >20 m<sup>3</sup> d<sup>-1</sup>), either boreholes, wells or springs, the majority for domestic, agricultural and industrial supply ([Moreau et al., 2004](#)). Of the licences granted for agricultural purposes a significant proportion are for spray irrigation. In addition, there are over 2300 private water supplies from Old Red Sandstone strata that are registered with local government, although many small sources such as supplies to single dwellings remain unregistered. At least 50 per cent of the known private supplies are for domestic use only.



Holy Spring at Maen-Du, north of Brecon Cathedral. P802423.

The Brownstones Formation and the Senni Beds are the best yielding formations in the Old Red Sandstone because the more transmissive sandstone of the Upper Old Red Sandstone are locally poorly represented. There are some large springs at the base of the St Maughans Sandstone. Among the sacred springs located north of Brecon is that at Maen-Du [SO 0390 2963] that formerly supplied Brecon Castle (**Plate P802423**). Most of the waters from the Old Red Sandstone are hard ([Jones et al., 2000](#)). The hard water favours tufa formation and fractures are commonly lined with travertine in cuttings or excavations.

The Old Red Sandstone waters are moderately fresh and tend to have low conductivities compared with other British groundwaters reflecting shallow and rapid groundwater circulation in the aquifer. Most groundwaters are either at or approaching saturation with respect to both calcite and dolomite.

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