

Hydrogeology of Wales: Precambrian and Cambrian aquifers - groundwater occurrence in the Cambrian

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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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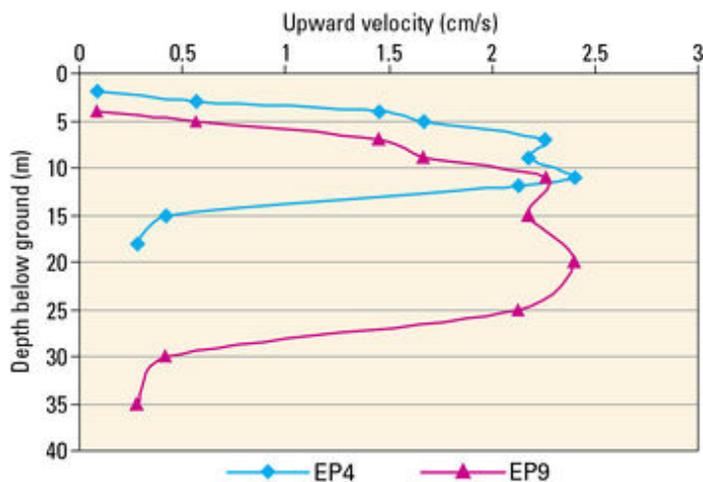
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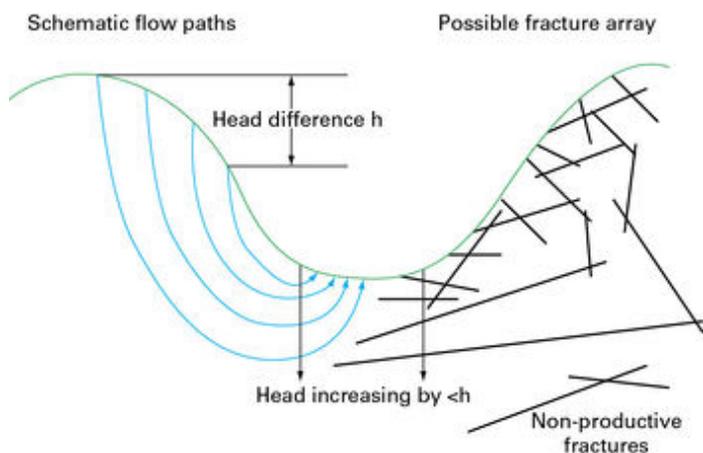
Llanberis slate quarry.
P802416.

Groundwater occurrence and circulation in the Cambrian sedimentary rocks is much the same as it is in the crystalline basement rocks described *above*. Groundwater is contained largely in the near-surface weathered and fractured zone of bedrock which offers little storage potential with transport via dilated fissures. Again, flow paths are typically short and shallow and are within catchment scale — usually down hill slopes towards valley bottoms. Spring discharges occur where fracture systems intercept the ground surface and along valley bottoms to provide base flow to surface waters. Steep topography over much of the Cambrian outcrop provides additional transport of ‘groundwater’, via soil or scree interflow, to discharge into valley bottom streams ([Shand et al. 2001](#)).

Although there are numerous springs associated with the Cambrian outcrops some are sourced partly, if not entirely, from overlying drift deposits. Collections from groups of bedrock springs have in the past been used for public supply. One example was the Nine Wells springs [SM 787 248] which were operated by the St Davids Water and Gas Company. The nine springs drained directly from bedrock slates into a chamber and delivered up to 225 m³ d⁻¹. In the same area of Pembrokeshire at Solva [SM 7862 2507] a 10 m-deep, 1 m-wide shaft penetrating a clearly visible fault in well-jointed fine-grained sandstone belonging to the Menevian Group, was capable of yielding up to 35 m³ d⁻¹. The static water level ranged between 1 m and 8 m below ground level depending on season.



Heat-pulse flowmeter logs for exploratory boreholes in Llanberis Slate Formation at Dinorwic (after Robertson, 1974). P859262.



Schematic cross section of a hard fractured rock upland valley such as Dinorwic, showing increasing head with depth in active fractures beneath valley bottoms. P859263.

In north Wales, detailed engineering investigations were carried out in exploratory boreholes in the Llanberis Slate Formation (**Plate P802416**) during the construction of the Central Electricity Generating Board's Dinorwic Pumped Storage Scheme in the 1970s ([Robertson, 1974](#)). Heat-pulse flow logs of two of the boreholes in the valley bottom (see **Dinorwic exploratory boreholes table**), measured under non-pumping conditions, are shown in (**Figure P859262**). These show upward movement of groundwater from the interception of the lowest active fracture in each of the boreholes EP4 and EP9. The upward flow continues to a point near the top of the water column in both boreholes. It demonstrates the increasing head with depth on active fractures in valley bottoms, and reflects the interception of successively longer flow paths, each upwelling along the valley bottom and derived from a higher recharge elevation on the valley side (**Figure P859263**). By contrast, exploratory boreholes EP5 and EP7 in the same vicinity were static throughout the

borehole column indicating constant head in the fractures penetrated reflecting poor contact with the overall fracture system.

Exploratory boreholes at the Dinorwic Pumped Storage Scheme in the Llanberis Slate Formation (Wellmaster record SH55/6 and 7).

Borehole	Grid Reference	Depth (m)	Rest water level on 5 March 1974
EP4	SH 5995 5875	36.8	1.2
EP5	SH 6007 5882	33.8	1.6
EP7	SH 6000 5881	52.3	1.8
EP9	SH 5983 5879	38.0	0.9

Boreholes EP4 and EP7 were also flow logged during pumping at 2 l s^{-1} . The flow logging was carried out with an impeller and fluctuating pumping rates caused some error to arise. However, the work showed that all the pumped water in EP4 derived from the uppermost 15 m of the borehole, reflecting the location of active fractures seen in the static log (**Figure P859263**.]). Borehole EP7 which showed no upward transport of water in the non-pumped state revealed its production zone to be located between 4 and 10 m below ground level, again demonstrating the shallow nature of active groundwater flow in these rocks.

Pumping was only maintained for brief periods at Dinorwic and sustainable yields are likely to be smaller than the recorded 2 l s^{-1} . Typical yields are about 0.5 l s^{-1} , for example from a 24 m deep borehole in the Ffestiniog Flag Formation at Criccieth [SH 5266 3991]. The static water table in this borehole is 1.3 m below ground level. However, it should be remembered that the distribution of springs and wells is significantly greater than that shown from the records in **Figure P859258**, as many sources have not been recorded.

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