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Extended Abstracts

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General hydrogeological problems

6.1
Hard rocks as specific media — methods and results

title: **Use of vertical head profiles to infer fractured zone properties above a Longwall Coal Mine**

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Longwall coal mining causes rocks to collapse into the void to form a caved zone. As mining proceeds, a fractured zone will develop above the caved zone with altered aquifer properties that will change with time (Fig. 1). The rocks in the fractured zone will have a higher vertical permeability from connected fractures and possibly higher horizontal permeability along dilated bedding planes. The fractured zone, considered as the extent of vertically-connected mining-induced fracturing, varies in height according to panel width, seam height and the competence of overburden strata. The depth of cover determines whether the effects of fracturing at depth might cause environmental disturbance to shallow aquifers or to aquifer-stream interactions. Constrained and surface zones will occur at higher altitude if the mine is deep (Fig. 1). The constrained zone in the overburden is likely to have competent sandstone/claystone lithologies that sag coherently rather than fracture extensively. This zone, by mediating the hydraulic connection between shallow and deep aquifers, will mitigate potential impacts at land surface.

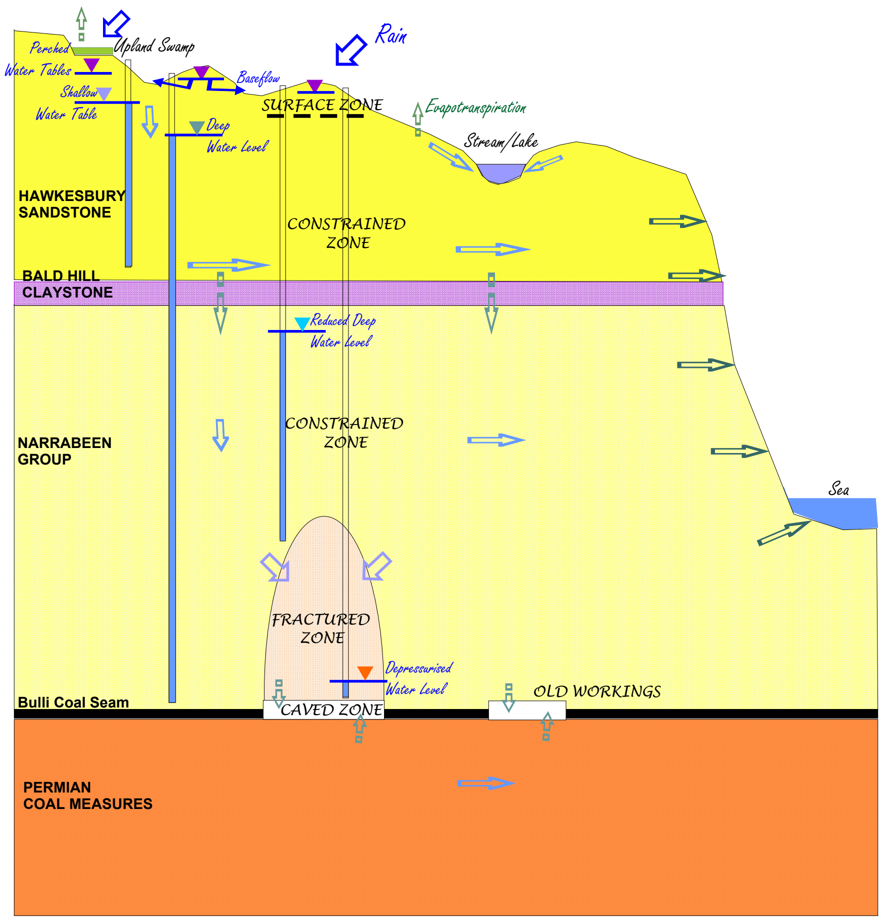

Figure 1. Conceptual hydrogeological model for a longwall coal mine in Australia.

This paper examines the response of an aquifer system at a particular coal mine in Australia where the depth of cover is 400–500 metres and the height of the fractured zone is about 130 metres. Given the difficulty of direct measurement of fractured zone properties, multiple vibrating-wire piezometers grouted in surface-to-seam boreholes can provide diagnostic data on vertical hydraulic head profiles at sites more or less affected by mining, with a facility for tracking head variations in time as mining approaches. Fractured zone hydraulic conductivities, at macro-scale, can be inferred from vertical head profiles through model calibration. An example of static head profiles is given in Figure 2 for a borehole drilled to the top of a fractured zone after mining had passed, and for another borehole about 4 km from current mining. Partial depressurisation is evident in the constrained zone above the area that has been mined.

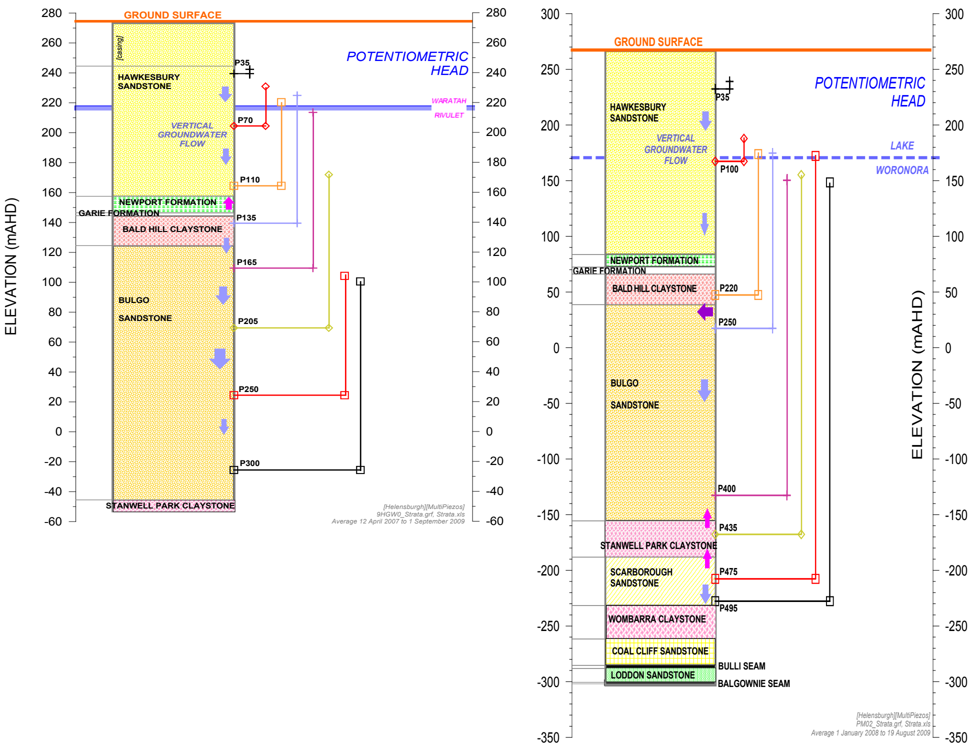

Figure 2. Vibrating-wire piezometer heads, vertical hydraulic gradients and inferred vertical flow directions at a mined area (left) and an unmined area (right).

Model calibration using PEST software has resulted in a median vertical permeability in the fractured zone that is higher than the host value by a factor of 8 to 14 for alternative models using different types and numbers of calibration targets. A model post-audit has provided verification of inferred hydraulic properties by successfully predicting the static vertical head profiles at three new surface-to-seam boreholes.

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